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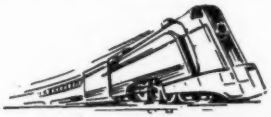

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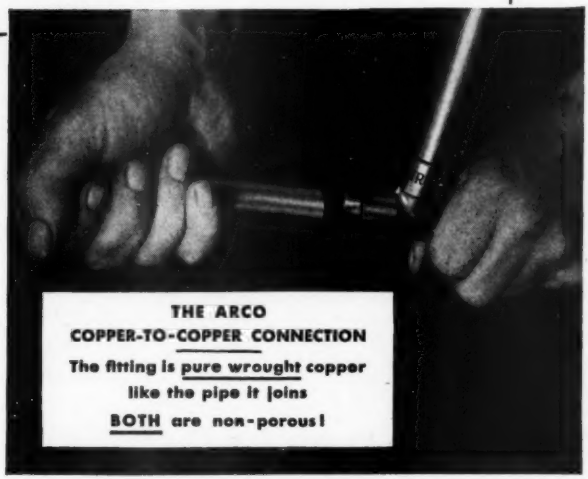

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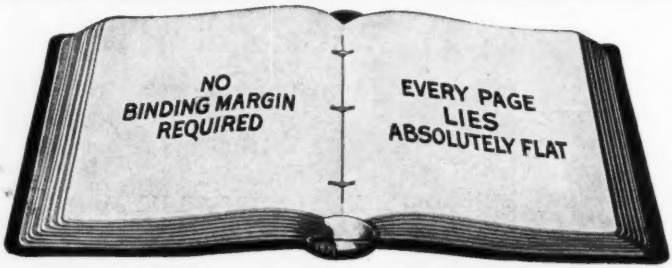

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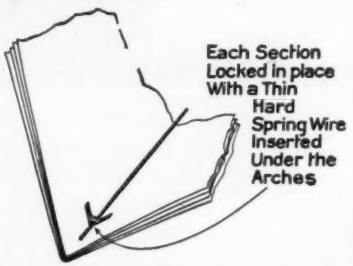

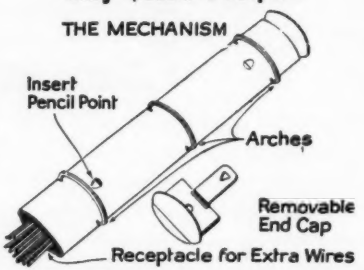

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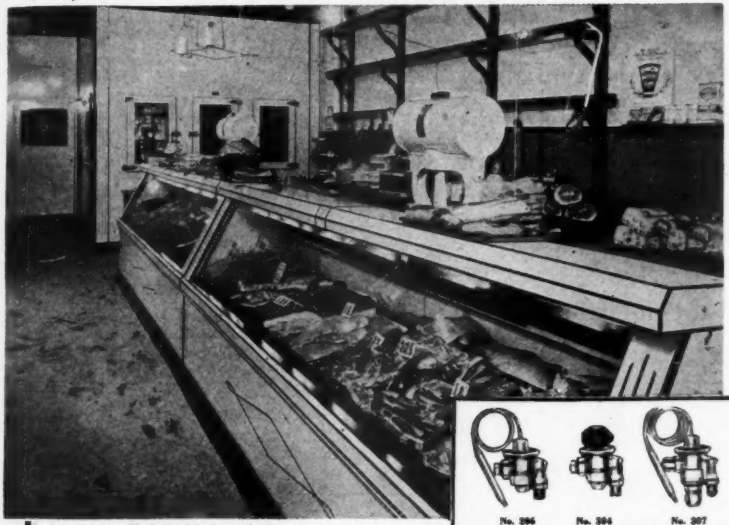

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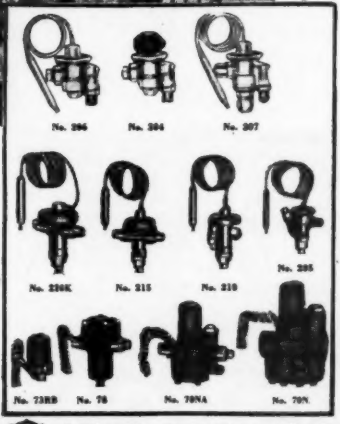

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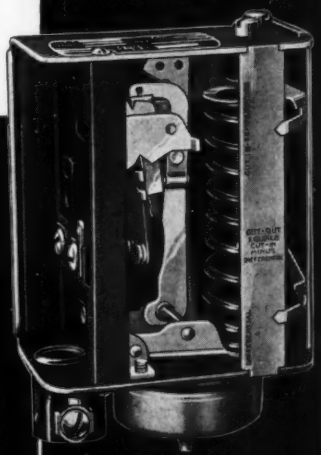

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The Refrigeration Service Engineer

VOL. 6, No. 12 CHICAGO, DECEMBER, 1938 $2.00 per Annum

Dryers and Drying Agents

By V. E. HALL*

MOISTURE in refrigerating systems has been discussed for many years but very little authentic information of a practical nature was given to servicemen until Dr. Walker and staff of the Ansul Chemical Co. research department published their findings in Vol. 1, Number 8, of Ansul News. The refrigeration service industry owes a debt of gratitude to Ansul for this work as I fail to see what pecuniary gain they expected to receive.

This talk is to cover the practical application of dryers, but I don't think any of us like to do a job in the dark and I think we all work more intelligently if we know a little of the theory back of what we are trying to do.

Dryers should never be used as a substitute for careful workmanship in installation and service. All reliable condensing units, coils, tubing, etc., are properly dehydrated before they are sent into the field. Good refrigerants and oils are dry in their original containers. Therefore, with proper care in dehydrating a new installation, no dryer should be necessary. Moisture will, however, enter a system due to failures, either mechanical or human and it is less expensive to dry a wet system with a dryer than to dismantle it for dehydration in an oven or even to discharge the refrigerant and dehydrate with a vacuum pump.

Let us review what happens when moisture enters a low pressure refrigeration system.

Water in Sulphur Dioxide

It is general knowledge that water combines with sulphur dioxide (SO_2) to form sulphurous acid (H_2SO_3). Many may remember from their chemistry studies that when sulphur dioxide is passed into water that some of the gas combines with the water to form sulphurous acid, while the remainder is held in a state of solution. The sulphurous acid is in equilibrium, on one hand with water and dissolved sulphur dioxide, and on the other with ion ($H+$) and (HSO_3) resulting from the ionization of a portion of the acid.

When heated this liquid acts as if it were simply a solution of sulphur dioxide in water, all the sulphur being evolved as sulphur dioxide. Toward a base on the other hand it acts simply as a solution of sulphurous acid. From our point of view, we may consider it simply as a solution of sulphurous

* Hall Refrigeration Co., Binghamton, N. Y.
Paper delivered at 5th Annual R.S.E.S. Convention, Buffalo, N. Y.

acid mixed uniformly throughout the liquid in the system.

We can conclude from this that we would have little success neutralizing this acid with a base (alkali), for as rapidly as we neutralized the acid more acid would be formed as long as any free sulphur dioxide remained.

It is therefore evident that a neutralizer is not going to help us. We must attack the problem from the other side, i. e.: removal of the water. Some refrigerator manufacturers told us that this was impossible. Fortunately, this is not true for if it were we probably could not obtain sulphur dioxide dry enough to use in refrigeration as in some stages of manufacturing, sulphur dioxide is so wet that water is removed by the bucketful.

As far as the formation of sulphuric acid goes it can probably be neglected for while sulphurous acid is a good reducing agent, taking up oxygen either from the air or from a substance rich in oxygen and changing into sulphuric acid (H_2SO_4), this action would be extremely low and at almost imperceptible rate in a refrigeration system even with a lowside leak supplying extra oxygen.

We can therefore, consider our problem as the removal of the water from a dilute sulphurous acid solution thereby reverting it to its anhydride SO_2.

There are several materials available that will do this very nicely if properly applied.

Water in Methyl Chloride

When water enters a methyl chloride system it reacts slowly and over a long period of time to convert an equivalent amount of methyl chloride (CH_3CL) into methyl alcohol (CH_3OH) and hydrochloric acid (HC_1). Both of these mix uniformly with the methyl chloride.

The action of this acid is particularly noticeable at the point of expansion in a system. This may be due to the greater velocity of the liquid at this point.

Another thing we are apt to notice in a methyl chloride system that contains moisture is a mechanical freeze-up at the point of expansion. When moisture enters a system it may collect at the needle seat and freeze, gradually building up enough ice to hold the needle open or as in most cases plug the orifice.

What we need to get us out of trouble in the above case is a neutralizer for the acid already formed and a water adsorber to remove any free water remaining.

Water in Freon

We know that mechanical freeze-up will occur when moisture is present in a Freon system and some acid reactions take place as there is a definite corrosion. Dryers may be successfully used on Freon.

Water in Isobutane

Moisture in Isobutane and similar refrigerants may be eliminated by using standard dryers.

Moisture Limits

Putting the ice forming and corrosion limits established by Ansul's report into everyday measurements we can readily see that very little is needed to cause plenty of trouble.

With SO_2 we have .03 percent by weight or $7000 \times .0003 = 2.1$ grains of water per pound of SO_2. For our purpose we may call this two drops per pound. Many summer days contain as high as 10 grains of water per cubic foot so we can readily see how little condensation or air is necessary to cause trouble.

Methyl chloride will stand less water than SO_2. Its corrosion limit is .02 percent and as little as .01 percent may freeze out in a hardening cabinet job.

When we look at the ice forming limit of .006 percent at 32 degrees for Freon-12, it would seem almost impossible to have a job operate without trouble as this amounts to only about one drop of water to two pounds of refrigerant. It speaks very well for both the manufacturers and the installation men that so little trouble has developed.

Drying Agents

Drying agents available to the serviceman are as follows:

Activated Alumina, Barium Oxide, Calcium Chloride, Calcium Oxide, Drierite, Silica Gel.

Activated Alumina is the trade name for aluminum oxide (Al_2O_3) prepared for dehydration of gases and liquids.

Drierite is the trade name for prepared anhydrous calcium sulfate ($CaSO_4$).

Silica Gel is the trade name for material manufactured from water glass and sulphuric acid or similar chemicals.

All of the above except Activated Alumina and Silica Gel pick up moisture by chemical reaction, i. e.: they change their chemical structure and in this case heat is given off. In the case of Drierite only part of its total dehydrating capacity is through

chemical reaction, the balance is obtained through adsorption.

Adsorbents remove water from a carrier gas only so long as the vapor pressure of the adsorbent is lower than the partial water vapor pressure in the gas. The vapor pressure in the above type adsorbent is practically zero until its breaking point is reached at some definite water concentration. The concentration that causes this breaking point lowers with a lowering of moisture content of the gas. In other words a pound of drying agent of this type will adsorb moisture at substantially 100 percent efficiency until it has picked up a certain amount of water depending upon the percentage of water in the gas. The greater the concentration of water in the gas, the more water it will adsorb at 100 percent efficiency. Temperature is also a factor, but the temperatures used in refrigeration can be neglected. When the break point is reached, the agent will continue to adsorb moisture at reduced efficiency until its vapor pressure reaches practical equilibrium with the partial pressure of the water in the gas. For the low moisture limits in refrigeration this partial pressure is very low and therefore the water adsorbing capacity of the adsorbent is very low compared to the advertised capacities which are based on drying of air with a relatively high constant water vapor concentration or vapor pressure. Another thing that lowers the capacity for refrigeration use is the fact that the drying is done in a closed system with a constantly reducing moisture concentration or vapor pressure.

Activated Alumina and Silica Gel dehydrate entirely by adsorption. No chemical or apparent physical change takes place. This fact probably accounts for poor results obtained in the past with Activated Alumina. We would undoubtedly have had equally poor results with Silica Gel had it been as widely distributed in this field. The poor results were not the fault of the drying agent, but due to poor handling by both the repackers and the servicemen. If Calcium Chloride picks up moisture in the can or jar, the serviceman knows it as soon as he opens it because its appearance has changed but Activated Alumina, Drierite, and Silica Gel look the same, wet or dry.

Some of the material offered to the serviceman is so wet that it will actually add moisture to a system rather than remove it. This is also true of some of the factory charged dryers. On the other hand some of the manufacturers are turning out a good product only to have it ruined on the jobber's shelves through poor packing or capping or careless handling by clerks. Drying agents should be purchased only in factory filled and sealed containers of small size. If large cans are opened and closed several times there is always the danger of contamination.

The manufacturer of Drierite gives a simple test to check the condition of this material. "Put about a tablespoon full into a small container such as a crucible or small ointment jar, insert your thermometer and sprinkle (don't drown), water on the Drierite. A rapid rise of from 18 to 36 degrees should be noted. If this rise is not noted the material needs regeneration." This same test will work on Activated Alumina and Silica Gel, but the rise in temperature will only be about ten to fifteen degrees as there is no chemical reaction.

Further Tests

A more sensitive test is made with a 15 percent solution of cobalt chloride in methyl acetone. This is made by dissolving one teaspoonful of the reagent grade in methyl acetone. Put this in a dropper bottle containing a little Drierite or Activated Alumina to dry it. When it is desired to test Activated Alumina or Drierite, simply drop three or four drops on the agent and note the color, if it stays blue for a few minutes, you may be sure the agent is pretty dry. If it almost immediately turns pink or rose red it would be well to reactivate it. This can be done by baking in shallow pans in your oven at about 350 to 400 degrees for two to three hours. Note how the rose color turns to blue when dried out. This is the basis of the indicating type agent put out by Activated Alumina and Drierite.

This test doesn't work so well on Silica Gel as the acetone seems to carry the cobalt chloride into the agent making it more difficult to note a color change.

In picking the type of drying agent to use the relative quality of the agent obtainable in your locality is far more important than the type. Activated Alumina is excellent for either a service or permanent dryer for any low pressure refrigerant. It works fair on low temperature applications.

Barium Oxide was used with good results on both sulphur dioxide and methyl chloride but it powders badly and the fumes are poisonous so why use it if you can get anything better.

Calcium Chloride is satisfactory for a service dryer but shouldn't be left on but a few hours as it will dissolve if much water

is present. In view of this it doesn't seem advisable to use it if you can get any of the better ones. It will, however, remove methyl alcohol that has been put in a system to prevent freeze-up.

Calcium Oxide doesn't have any favorable qualities so there seems to be no excuse for using it. It will neutralize acid in a methyl chloride system but so will a little steel wool.

Drierite is excellent for either a service or a permanent dryer. It works well on low temperature applications.

Silica Gel is excellent for either a service or permanent dryer. It powders the least of any tested and works well on low temperature applications.

Zinc will not remove water although advertised to be used on SO_2 jobs. It is worthless by itself and is no better than steel wool for a neutralizer in conjunction with a drying agent on methyl chloride with which it may form an explosive combination.

To summarize the above we can say that Activated Alumina, Drierite, and Silica Gel are the logical choices. Under field conditions where the water concentration is continuously changing rather than constant it is doubtful if anyone could say one of the three is better than the other two. In the laboratory Activated Alumina seems to remove moisture to a lower residual concentration in SO_2 while Drierite appears to have the edge with methyl chloride and Freon, Silica Gel falls between the two on all three refrigerants. These are laboratory conditions and the figures are so minute that they don't mean much in service work except on low temperature applications. A variation in the quantity of drying agent per pound of refrigerant for the same initial concentration of water would vary the water concentration in the drying agent at the exit end of the dryer enough to change the results. Drierite is not as fast as the other two on high concentrations of water but fast enough for the average wet job that is still running.

Application of Dryers

The following recommendations are not set forth as hard and fast rules, but may be used as a guide for best practice:

Let us take for example the case of a stuck up SO_2 compressor. The trouble was caused by a seal leak. No other damage is apparent. We remove the compressor and rebuild it. When reinstalling the compressor a dryer should be placed in the suction line to prevent the wet gas from sticking it up again. Another reason for the suction line installation is the fact that moisture can be removed from the SO_2 vapor faster than from the liquid. This dryer would preferably be charged with either Activated Alumina or Silica Gel of about four mesh size. The reason for the large size is to reduce the pressure drop as even with this size and a large dryer, it may be necessary to set the low pressure switch down a little in order to keep proper temperatures. This dryer should be left on for several days to be sure that all the moisture has been boiled out of the lowside in which it has a tendency to concentrate. In bad cases it is well to pump the job down after the dryer is installed and heat the lowside good with a torch while pulling a vacuum on it. This will vaporize most of the moisture and as the compressor is drawing it through the dryer it will be adsorbed immediately. After removal of the suction dryer a permanent dryer should be installed in the liquid line to pick up the balance of the moisture as your service dryer charge will have picked up enough moisture so that its vapor pressure is too high to dry the refrigerant to the lowest possible point. Either Activated Alumina, Drierite or Silica Gel may be used.

When a Water Cooled Condenser Breaks

In the case of a broken water coil in a water-cooled condenser it would be well to dump the whole charge as you probably will have enough water in the system so that a dozen dryers wouldn't take it out. If possible it would also be a good idea to draw hot dry air through the system before recharging. The air can be dried with a large dryer and then heated with an old gas hot water heater. Better remove any fusible plugs from the system before doing this. Install suction line dryer for a few days and then a permanent liquid line dryer charged with either of the three agents.

Suppose you wish to protect a new case or coils connected to an old condensing unit. The unit has been operating but is old and you don't wish to contaminate the new fixture with the least bit of moisture. It is evident that the moisture content can't be too high if the compressor is okay so a permanent liquid line dryer is all that is necessary.

In other words just use common sense and stop the moisture going from wet to dry sections of the system.

If you dismantle a methyl chloride com-

pressor and find excessive corrosion or a rank muriatic acid smell, you can be sure the system has a bad case of acidosis. Put a pad of extra fine wool at the inlet end of your dryer to break down the acid. The acid will work on the steel wool faster than on the cast-iron in the compressor and will be used up before doing more damage. Silica Gel will dry a very wet methyl chloride liquid as rapidly as it will the vapor, but Drierite and Activated Alumina work faster on the vapor phase.

Low Temperature Work

For another example take one of those hardening cabinets that operates all right until it reaches say ten below zero and then freezes at the expansion valve. Put on a factory charged dryer that has been charged with hot agent or activated after charging. Don't depend on your old reliable shell and run of the stock agent for this as the vapor pressure of the dryer may be as high as the vapor pressure of water in the refrigerant, in which case no water removal would take place. If you have time you can activate your dryer after charging by baking it for two hours at 350 to 400 degrees. It should be connected to a vacuum pump during this time to draw off the water vapor so that it won't remain in the shell. Felt pads don't stand this temperature very well so use pads of extra fine steel wool. If Activated Alumina or Drierite is used, follow the dryer with a felt pad filter to catch any powder from the drying agent. You may get away without the filter if you use Silica Gel as there is little or no powder from it. Another method that is almost as good as the above is to activate the agent in shallow pans at the high temperature and dry the dismantled shell and pads at about 250 degrees; then assemble and charge the dryer while everything is hot. For low temperature (zero and below) methyl or Freon work, Drierite is best, with Silica Gel a close second. The above order is based on a low initial concentration of water, say a job that doesn't freeze at twenty degrees above zero but does at some temperature below that or where it is desired to protect a new job for low temperatures.

Dryers should be mounted vertically with the outlet pointing in the direction of gas or liquid travel. This will give the best contact and allows for good oil circulation.

The quantity of drying agent to use for various jobs is a hit or miss proposition. In general, use as large a dryer as practical on a wet system. Use at least a tenth of a pound of drying agent to a pound of refrigerant in service dryers. Permanent dryers put on after service dryers or as a precautionary measure may run one-half of this. Remember that you can use too little but not too much on a wet job.

Many of you may use a dryer ahead of the vacuum pump on your oven, and you are always wondering if it is saturated but can't be sure until the pump sticks-up. Try filling a chemical flask or test tube with indicating type Activated Alumina or Drierite, close the flask with a two-hole rubber stopper with the inlet tube run through the agent, insert the outlet tubing in the other hole and connect between your regular dryer and the pump. When all the agent in the flask has turned pink it is time to change your dryer as water is going through to the pump.

S S S

COMMENTS ON PAPER— "DRYERS AND DRYING AGENTS"

by E. W. McGOVERN*

MR. HALL is to be commended for presenting a paper which includes valuable practical information on drying agents as well as the underlying theory with high degree of technical accuracy. I would like to add some comment in the nature of elaboration rather than criticism of some of the items covered by Mr. Hall.

There may be a misunderstanding in believing that some refrigerator manufacturers feel that it is impossible to dry sulfur dioxide systems as it certainly has been known to machine manufacturers that sulfur dioxide is satisfactorily dried in the course of its manufacture. The main difficulty about sulfur dioxide and moisture is that by the time the presence of moisture is known it is often too late, since the system is already too badly damaged to accomplish much or any good by installation of a dryer. In the case of refrigerants such as methyl chloride, reaction with water to form acid is slow, not immediate as in the case of sulfur dioxide. Installation of a dryer within a reasonable period of time on a wet methyl system, say within a few days or weeks, will thus avoid trouble while a sulfur system would be badly

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corroded in this time. Further, sulfur systems do not warn of the presence of moisture by freeze-ups. Still another consideration is that conditions of drying in the manufacture of sulfur dioxide differ from those in a refrigerating machine. Complete removal of water from a sulfur machine by dryers is slow and is more difficult than in the case of refrigerants such as methyl.

Our experience has indicated that a calcium oxide dryer has some advantages when installed temporarily on methyl systems. It appears to be more rapid in taking up water than the adsorptive agents, it has a higher capacity and it neutralizes acid. Because of its neutralizing effect, it like soda lime, appears to be effective to some extent in preventing "copper plating." It should be used only temporarily because of its great tendency toward disintegration (although the particles are claimed to be soft and therefore relatively non-abrasive) and because of its slow reaction with refrigerants such as methyl to form calcium chloride. It and other alkaline dryers for refrigerating systems are claimed by a patent issued to the Chicago Pneumatic Tool Company.

Barium Oxide

Barium oxide is much like calcium oxide but in addition to the disadvantages mentioned, we have been informed that it takes up moisture so rapidly and with such evolution of heat that dryers charged with it have been known to explode. Perhaps reaction with refrigerant is also involved. This material therefore should not be used on refrigerating systems.

We advise against use of calcium chloride, even temporarily, because of possible solution of the material and consequent corrosion of the system. Calcium chloride is water soluble and the resulting brine is corrosive. Drierite (calcium sulphate), activated alumina, Silica Gel and calcium oxide are all essentially insoluble in water and refrigerant. While calcium chloride will take up methyl alcohol, I do not believe this is an important advantage as pure methyl alcohol in the absence of water appears to have little or no effect in the system.

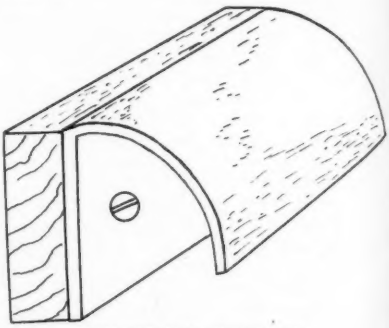
Activated alumina has been tested in the du Pont laboratories for acid absorbing qualities and we have found that it can reduce acid in methyl chloride systems to a very low percentage. This may be due to adsorption of the hydrochloric acid or its water solution in which case similar results might be expected with Drierite and Silica Gel which we have not tested. However, it would appear that activated alumina, being amphoteric and therefore capable of reacting as either an acid or a base, may be at least aided in acid removal by reacting with hydrochloric acid to form aluminum chloride.

S S S

PROTECTING PARTS FROM VISE MARKS

SOFT, or finely finished metal parts, such as brass, copper, aluminum, chromium, etc., are often damaged, or marred when gripped in a vise while assembling or repairing.

As an accessory to your vise to overcome this, make two blocks, as shown, out of hardwood, and of a length equal to the width of the vise jaws. Fasten to these blocks with countersunk wood screws, a piece of heavy sheet metal bent to fit over the jaws of the vise.



BLOCKS FOR YOUR VISE

The finished blocks provide an easily attached protection for the parts to be held. The wood blocks may be provided with V-shaped or round slots, as desired, for holding round or irregular objects.

S S S

Russell A. Bost,
Illinois

I am a new subscriber to your magazine, but for it 100 per cent.

M. J. Hardick,
Virginia

Having recently become a subscriber to THE REFRIGERATION SERVICE ENGINEER, I am very much pleased with this publication.

The Automatic Constant Pressure Expansion Valve

Reasons for Proper Adjustment and Effects on System Efficiency

By L. K. WRIGHT, M.E.

EVERY service man is familiar with at least a half-dozen makes and designs of automatic constant pressure expansion valves. Regardless of manufacturer or design involved, this type of throttle device serves to perform the following functions:

1. Separates the high from the low side.
2. Acts as a throttle device in that it feeds or meters a certain measured quantity of liquid refrigerant to the evaporator per unit of time when the compressor is in operation.
3. Maintains a constant back pressure, predetermined and set by the operator.
4. As soon as the compressor stops operating the valve automatically closes and prevents any more liquid from passing to the evaporator, regardless of the quantity stored in the receiver.

A Typical Valve

The sketch shown in Fig. 1 illustrates a typical automatic constant pressure expansion valve, all the parts being labeled for identification. It will be observed the body and the inside of the bellows are subject to the pressure conditions existing in the low side. Opposing this low side pressure is the spring tension, which may be increased or decreased by manipulation of the adjusting screw.

Any increase of pressure within the bellows and body serves to close the valve. The expansion and movement of the bellows results in pulling the needle into tight contact with the seat, cutting off the flow of liquid refrigerant to the low side.

A decrease in pressure, when the gas pressure is lower than the push exerted by the adjusting spring, serves to open the valve, the needle being lifted off its seat and permitting liquid to pass through the valve.

As an example of operation refer to the plotted chart, Fig. 2, which is the data involved in a valve set, let us say, for five lbs. of back pressure. In tracing the action note when the machine starts the valve is closed and remains so until the back pressure is reduced to the working point; then the valve opens and feeds that quantity of liquid required to hold the low side at the selected back pressure. This pressure will be held regardless of length of run or variance in load.

Just as soon as the machine stops, pressure builds up in the low side and serves to close the valve. Actually, as the compressor slows down the valve starts closing and as soon as the compressor has come to a stop the valve has fully closed. It will remain in this closed position until the compressor has started again and reduced the back pressure to the working point once more.

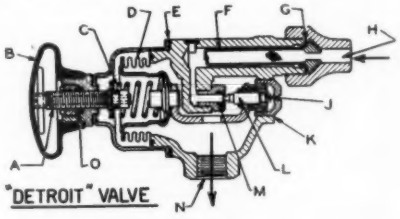


FIG. 1.

A—Adjusting screw.
B—Adjusting screw breather cap.
C—Adjusting spring.
D—Bellows.
E—Moisture tight joint.
F—Strainer.
G—Copper gasket.
H—Inset connection ¼" copper tube.
J—Needle Swivel.
K—Plug hermetically sealed with solder.
L—Special stainless steel needle.
M—Special stainless steel seat.
N—Outlet connection.
O—Moisture tight packing.

The chart indicates a total variance of .2 pounds. Actually, it is less than this. The needle itself does not move out of the seat to any great extent; it merely loosens its contact. Bear in mind the inside of the valve is subjected to low pressure (varying from 12 inch vacuum to a pressure of a few pounds, depending upon the refrigerant and the application), while the pressure in the high side is upwards of 60 lbs. Thus, at the slightest tendency to lift, liquid will pass, due to the pressure difference.

Field of Use

The automatic constant pressure expansion valve finds principal use in the household field for several reasons. It is of relatively low cost. It may be used with a dry coil, such an evaporator in turn being the cheapest to manufacture, as it is formed of one continuous piece of tubing and, being without welds or joints, is not subject to leakage.

Again the automatic expansion valve finds logical use on the household machine because refrigeration loads are more or less of a constant nature, but it is not so suitable for the commercial field, as it does not compensate for variable loads.

Such a valve is easily adjusted and can be reset for other back pressures. It is not suitable to a system where close control of temperature is required in a multiplicity of refrigerators, as only one valve can be used in a system.

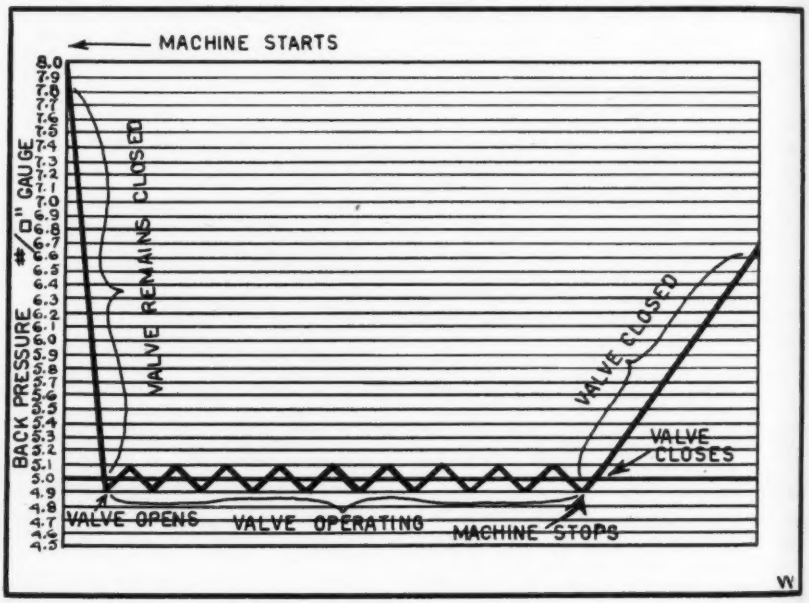


Fig. 2. Portraying the action of an expansion valve set for five pounds pressure.

Operation

In operation this valve feeds the correct quantity of refrigerant required to keep the low side at the pressure to which it is set to operate. In other words, it feeds a certain specified quantity of liquid refrigerant per minute, dependent upon the volume of gas the compressor can handle.

As an example of operation let us take a specific case, starting with the high side. One of the older Frigidaire models will serve as an excellent example, the unit being the T L job. This was the little package unit, the motor, compressor, condenser, receiver and thermostat being mounted on the top of an insulated panel, with the evaporator coil hung below it, so the entire assembly could be lifted out of the top of the refrigerator for ease of replacement or service.

The compressor was a single-cylinder design, having a 1⅝ inch bore x 1⅝ inch stroke, operated at 420 r.p.m. A 1/6 hp. motor was used and the rating of the assembly, based on 80 degrees F. condenser, with a back pressure of 7 inches vacuum, operated for a 14 hour period, was 45 lbs. i.m.e.

To find the capacity for this sulphur dioxide compressor the following formula is used:

Area of piston × stroke × r.p.m. × min. = capacity in cu. in. per hour.

The area of the piston is found by squaring the diameter and multiplying by .7854. The result is:

$1.625 \times 1.625 \times .7854 = 2.07$ sq. in. area.

Proceeding further we find the problem can be worked out, using the following:

$2.07 \times 1.625 \times 420 \times 60 = 84{,}767$ cu. in. per hour theoretical displacement.

Refrigerant Data

Referring to a saturated table of sulphur dioxide, we find the following set of conditions:

0 degrees F. Temperature
8.85 inches Vacuum Gauge Pressure
7.28 cu. ft. volume of vapor
183.07 total heat in vapor

Let us select this as a working point and determine capacity with this 8.85 inches vacuum instead of the 7 inches vacuum rating, as we will work with this condition in another problem.

The heat content of liquid sulphur dioxide at 80 degrees F. is 40.05 B.t.u.

Therefore, the refrigerating effect of one pound of sulphur dioxide admitted into an evaporator in which it can boil at 0 degrees F. and assuming it enters the expansion valve at 80 degrees F. would be:

183.07
40.05

143.02 B.t.u. per lb. refrigerating effect.

The compressor is rated at 45 lbs. i.m.e. per 14 hr. operation, or 3.2 lbs. i.m.e. per hr. hr.

Theoretical and Actual Performance

The theoretical displacement of the compressor was found to be 84,767 cu. in. per hr. Its actual performance is given as capable of handling that quantity of gas corresponding to 3.2 lb. i.m.e. per hr.

The refrigerating effect, as per previous outline, was found to be 143.02 B.t.u. per lb. of sulphur dioxide evaporated in the coil. One pound of sulphur dioxide vapor at 0 degrees F. has a volume of 7.28 cu. ft., or $7.28 \times 1728 = 12{,}579.8$ cu. in. An i.m.e. of 3.2 lb. would involve the removal of $12{,}580 \times 3.2$, or 40,256 cu. in. per hr.

Compressor efficiency may be found as follows:

$$\frac{40{,}256}{84{,}767} = 48 \text{ per cent}$$

Small compressors of this type have efficiencies ranging from 25 to 70 per cent; larger types up to 85 per cent. Therefore, this compressor may be taken as representative of a good type of the small size pump.

If this compressor, as per its rating, is able to handle that quantity of gas necessary to produce a refrigerating effect of 3.2 lb. i.m.e. per hr., this in B.t.u. value would be: $144 \times 3.2 = 460.8$ B.t.u. per hr.

The refrigerating effect was found in previous work to be 143.02 B.t.u. per lb. of liquid evaporated. Therefore, the actual pounds of liquid to be evaporated is: 3.2 lb.

Action in Evaporator

To simplify the explanation let us assume an evaporator coil of copper tubing, fifty feet in total length, immersed in a brine tank containing 25 lb. of alcohol brine, as per Fig. 3.

Assume the tube size is such that its conductivity is one B.t.u. per ft. per degree temperature difference between brine and refrigerant.

The alcohol brine used in the industry is usually a mixture consisting of 40 parts alcohol to 60 parts water. This is about 10 gal. of alcohol to 15 gal. of water basis. Such a mixture has a freezing point of —2 degrees F., a specific gravity of 1.175 and a specific heat of about .88. For the latter let us assume .8.

Further, let us assume the brine tank to be provided with a perfect insulating cover so that no heat will enter from the surroundings. The heat content of coil and tank will also be ignored.

We will assume the refrigerant is to be evaporated in the coil at zero degrees F. and that the brine is to be cooled from 80 degrees F. to five degrees F. The automatic constant pressure expansion valve will be set to hold 8.85 inches vacuum and as 3.2 lbs. of sulphur dioxide will be evaporated per hr. the heat removal will be at the rate of 460.8 B.t.u. per hr. Let us drop the .8 and take 460. as the heat removed.

Starting with brine at 80 degrees F. and the evaporating temperature at zero degrees F., the temperature differential would be 80.

With this condition the actual length of coil which is active is:

$$\frac{460}{80} = 5.7 \text{ ft.}$$

The greater the temperature differential the faster the heat flow. Under the conditions just given we find 5.7 ft. of the copper tube has sufficient surface to absorb the heat

required to vaporize 3.2 lbs. of sulphur dioxide, or in refrigerating effect to absorb 460 B.t.u.

The brine weight is 25 lbs. Its specific heat .8, therefore to cool it one degree F. would require the extraction of $25 \times .8 = 20$ B.t.u.

At the end of ½ hr. 230 B.t.u. would have been extracted ($\frac{1}{2} \times 460$) and the brine reduced 11½ degrees in temperature. Now a cooler brine is had, as well as a lowered temperature differential. We could go on using the correct figures and it would necessitate the use of a slide rule or pencil and paper. Let us forego this and put the work on a simple basis, so it can be followed by mental calculation.

Assume, therefore, that the compressor is able to handle 400 B.t.u. per hr., brine at 80 degrees F. and refrigerant at 0 degrees F. throughout run.

At the start the effective coil length would be:

$$\frac{400}{80} = 5 \text{ ft.}$$

With the brine reduced to 70 degrees F. the effective length of coil would be:

$$\frac{400}{70} = 5.7 \text{ ft.}$$

With the brine reduced to 60 degrees F. the effective length of coil would be:

$$\frac{400}{60} = 6.6 \text{ ft.}$$

With brine at 50 degrees F. the effective length would be:

$$\frac{400}{50} = 8 \text{ ft.}$$

With 40 degrees F. brine $= \frac{400}{40} = 10$ ft.

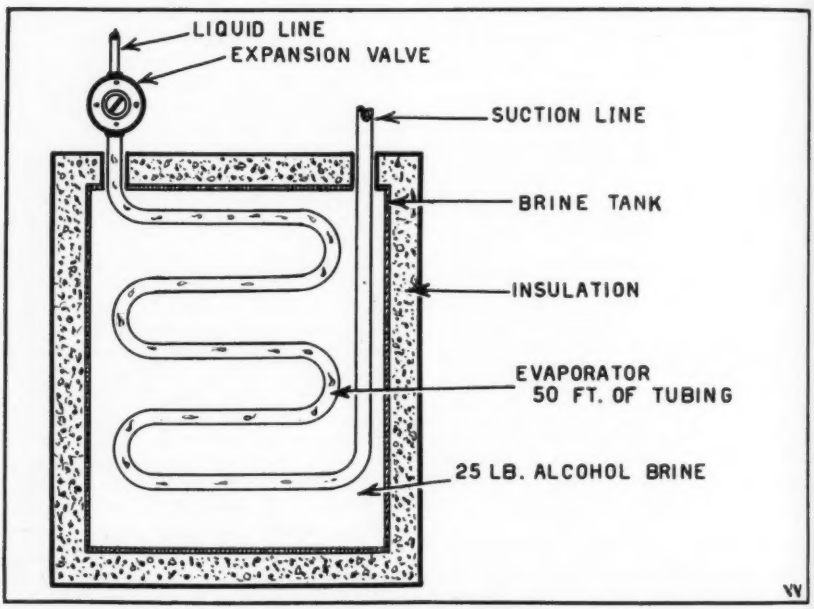


Fig. 3. A typical brine tank set up.

By tabulating the results we can make up a chart easily checked for the period of the run as shown in table 1.

Thus we get a picture of the operation. With the greater temperature differential less coil surface is needed. As the temperature differential decreases more coil surface is required. With brine at eight degrees F. the entire coil would be active. If we wanted to continue to operate the machine and re-

Table 1—Refrigerant at zero degrees F.

Brine Temperature	Temperature Difference	Effective Coil Length
80	80	5
70	70	5.6
60	60	6.
50	50	8.
40	40	10.
30	30	13.3
20	20	20.
10	10	40.
8	8	50.
5	5	80.

duce the brine to five degrees F. we would find liquid refrigerant passing through to the suction line, resulting in a frost-back condition.

Obviously if we do not wish this to occur it would be necessary to reduce the back pressure and reduce the quantity of liquid passing into the coil. Operation of the system under this lower pressure condition would involve a longer running time.

We learned the compressor operating with a zero degree F. suction gas would be rated as producing a refrigerating effect of 460 B.t.u. per hr. To reduce the brine temperature one degree F. it was found 20 B.t.u. would have to be removed. With brine at 80 degrees F. at the start and assuming it desirable to cool it to five degrees F., the temperature drop or differential would be 80 — 5 = 75 degrees.

Total heat to be handled would be:

$75 \times 20 = 1{,}500$ B.t.u., or working the long way, the entire formulae would be:

25 lbs. brine × .8 sp.ht. × (80°—5°) = 1,500 B.t.u.

If the total heat load is 1,500 B.t.u. and machine is capable of extracting 460 B.t.u. per hr., the length of run under these conditions would be:

$1{,}500 \div 460 = 3\frac{1}{4}$ hrs.

Result of Readjustment

Obviously we would not want a frosted suction line and we would reduce the back pressure. Let us see what would happen if we readjusted the expansion valve to hold at about 14 in. vac. (13.91 inches), which corresponds to —10 degrees F. boiling point. The total heat per lb. of sulphur dioxide evaporated under this condition is 182.13 B.t.u., slightly lower than in the previous case. However, of more importance, is that the resulting gas from a pound of liquid under these conditions occupies 9.44 cu. ft. of space. At zero degrees F. it displaced only 7.28 cu. ft.

$\frac{9.44}{7.28} = 1.296$ or roughly 1.3 more gas to be pumped—and 1.3 more time to do this work, disregarding the fact that the lower temperature gas has a slightly lower latent heat value. Thus, if $3\frac{1}{4}$ hr. was the run in the previous case, it will be necessary to operate 3.25×1.3 or 4.225 hrs., or roughly $4\frac{1}{4}$ hrs.

If 1500 B.t.u. is the load and the compressor did the work previously in $3\frac{1}{4}$ hrs., under present conditions the compressor would only remove 352 B.t.u. per hr. Let us assume 350 for the sake of convenience.

A check over the effective coil length would bring out the following:

Table 2—Refrigerant at 10 degrees F.

Brine Temperature	Temperature Difference	Effective Length of Coil
80	90 $\frac{350}{90} =$	3.8 ft.
70	80 $\frac{350}{80} =$	4.3 ft.
60	70 $\frac{350}{70} =$	5. ft.
50	60 $\frac{350}{60} =$	5.8 ft.
40	50 $\frac{350}{50} =$	7. ft.
30	40 $\frac{350}{40} =$	8.7 ft.
20	30 $\frac{350}{30} =$	11.7 ft.
10	20 $\frac{350}{20} =$	17.5 ft.
5	15 $\frac{350}{15} =$	23.3 ft.

Less than half the coil would be active at the end of the run and the thing to do is raise back pressure to that point at which the coil would be entirely active when the brine had attained the desired temperature

of +5 degrees F. Let us select a —5 degrees F. condition, which involves an 11.52 inch vacuum. The volume of vapor per lb. at this pressure is 8.28 cu. ft., or:

$$\frac{8.28}{7.28} = 1.13$$ more gas to be pumped than at the zero degrees F. condition, and 1.13 more operating time. In this case the operating time would be:

$$3.25 \times 1.13 = 3.672 \text{ hr.}$$

If 1500 B.t.u. is the total heat load and the compressor will remove this quantity of heat in 3.672 hr., the work per hr. is: 1500 ÷ 3.672 or 408 B.t.u. per hr. This is so close to 400 that we can use this figure as the basis of the new estimate.

With refrigerant at —5 degrees F. and brine reduced to +5 degrees F., the temperature differential would be 10 degrees and the feet of effective tubing would be:

$$\frac{400}{10} = 40.$$

We could set our expansion valve therefore for about 10 in. of vacuum, this in turn increasing the temperature to about —3 degrees F. With this setting an eight degree differential would be had at the end of the run and the effective coil length would be—

$$\frac{400}{8} = 50 \text{ ft.}$$

From the foregoing an insight as to the increase or decrease in the heat removal rate is gained, as well as time element and coil effectiveness. Hence, the admonition—operate with the highest possible back pressure for highest coil and compressor efficiency and shortest running time.

Air Conditioning Soft Wheat Laboratory

AN installation in air conditioning that was somewhat out of the ordinary was made by Refrigeration Economics Company, Canton, Ohio. This was a federal contract with the Department of Agriculture originally placed with a dealer who found himself unable to execute the contract. Reco took over the job, furnishing and installing all equipment.

The installation was made at the Federal Soft Wheat Laboratory of the Ohio Agricultural Experiment Station at Wooster, Ohio. It seems there are some five or six hundred different varieties of wheat. Some of these cannot be grown profitably by the farmer; others suit the farmer but cannot be used advantageously by the millers or bakers.

The purpose of the Federal Soft Wheat Laboratory is to determine experimentally the best varieties of wheat and the most advantageous way of milling and baking these varieties.

Knowing that air conditioning has some effect on milling and baking processing, the Department of Agriculture authorized the installation of air conditioning equipment in three rooms of this laboratory. The requirements were as follows:

Room (1)—used for milling, size about 9 x 19 x 10 feet high, is maintained at any desired temperature between 70 and 90 degrees with any outside temperature from minus 10 degrees up to 95 degrees and the allowable variation of plus or minus one degree F. In this room they require any humidity from 50 to 90 per cent with not over plus or minus two per cent variation. In this room it was required to produce extreme conditions of 90 degrees and 90 per cent down to 70 degrees and 50 per cent.

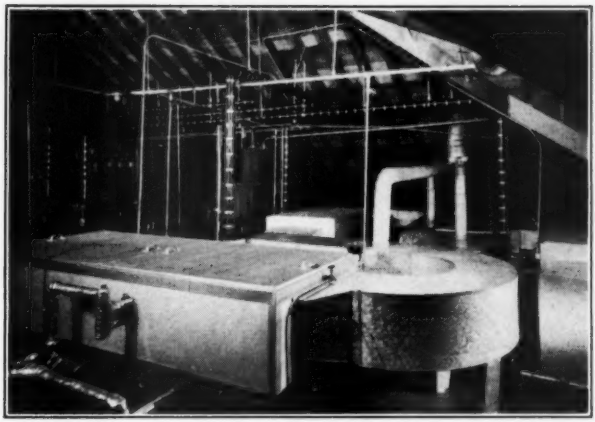
Room (2)—used for the bakery, size about 12 x 18 x 10 feet. The requirements are any temperature from 70 to 95 degrees with the same outside air temperatures and with variation of not over plus or minus one degree F. No humidity regulation was required.

Room (3)—the laboratory, size 11 x 18 x 10 feet. The requirements are any temperature from 65 to 95 degrees with no control of relative humidity.

The government specifications did not go into any further details except that the air from Room (1) had to be washed to take out the flour dust and they did specify that pneumatic controls had to be used.

Reco had only 60 days to design and manufacture equipment and get it installed in as short a time as possible. Total time elapsed was 60 days.

Two Mills two-horsepower condensing units and one three-horsepower unit were used, the three horsepower being for the mill room. The control equipment was furnished and installed by the Minneapolis-Honeywell



THE LARGE COOLING UNIT WHICH SUPPLIES THE MILL ROOM.

Company, using National pneumatic apparatus.

The largest Mills unit was for the mill room and was equipped with a pre-heating coil at the inlet. Next came scrubber plates, which are constantly sprayed with fresh water to take the flour dust out of the air. This fresh water drains to the sewer. Next is the spray compartment supplied by a Westco spray pump, of course recirculating most of the water. Then there is a Freon cooling coil, an eliminator, a reheat coil and finally Peerless air blowers directly connected to one motor.

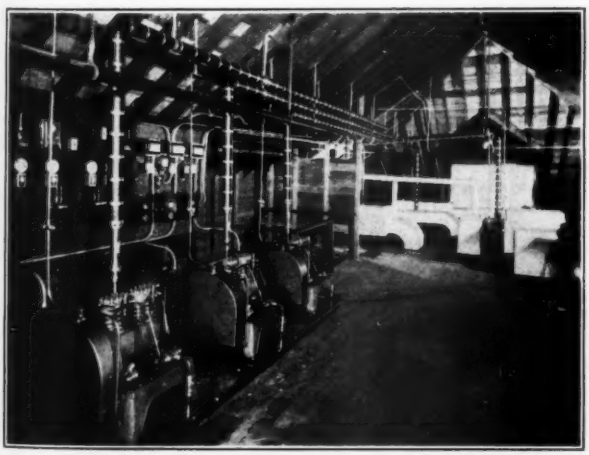
Units of the other two rooms consist of the shell with air filters, cooling coils, heating coils and blowers.

All coils were Reco copper and aluminum finned construction and all Freon coils were equipped with distributors to meter the same amount of refrigerant to each horizontal coil.

Special thermostats and controls were made up to correct lack of sensitivity in maintaining temperatures and relative humidities within the specified limits.

During the testing a six-point electric recording thermometer was installed for a period of several weeks to produce an exact record of dry and wet bulb temperatures in the mill room and dry bulb temperatures in the bakery and laboratory as well as outside air temperatures.

Dr. E. G. Bayfield, cereal technologist in charge of this experimental station, was at first very apprehensive of vibration troubles, thinking that the results of their delicate weighing operations might be impaired. However, he was very agreeably surprised to find that the Mills condensing units were practically noiseless and caused absolutely no vibration in the laboratory rooms.



THE THREE MILLS CONDENSING UNITS USED IN THE INSTALLATION.

Pressure Drop in Suction Lines

By E. GYGAX—Curtis Refrigerating Machine Co., St. Louis, Mo.
KARL S. WILLSON and GEORGE H. CLARK*, Ansul Chemical Co., Marinette, Wis.

ALTHOUGH knowledge of the pressure drop to be expected in suction lines has long been recognized as essential in correctly designing refrigeration and air conditioning installations, complete experimental data have been lacking or their use buried in a maze of complicated calculations. Linebaugh [1] and Stickney [2] have both reported some data with correlation to general formulae, but the data are believed to be insufficient from an experimental viewpoint in the first case and more involved than necessary in both cases, for as general use as the subject deserves.

Schultz, in a series of articles,[3] has presented considerable valuable information but the data are given in terms of allowable carrying capacity of suction mains, based on more or less arbitrary limits which do not permit judgment in balancing operating costs against initial investment.

In the belief that actual experimental determination of the pressure drops in various sizes of pipes under various conditions would be valuable, the work reported below was undertaken. The data have since been found to check quite accurately a general formula for fluid flow, from which a comprehensive table of data has been prepared.

Experimental Apparatus and Results

The test apparatus consisted of various sizes (½ to 20 hp.) of Curtis compressors, an electric calorimeter which acted as evaporator and superheater, and the test pipe to which suitable gauges were attached at each end in order to measure the pressure drop. The calorimeter served to measure the operating capacity under the given conditions. The feed liquid entered the calorimeter at 90 degrees F. (room temperature) and the gas was superheated to 65 degrees F. The temperature of evaporation was maintained at 0 degrees, 20 degrees and 40 degrees F. in the various tests. Although slight variations in liquid and suction gas temperatures occurred, these variations were held to a minimum and, as will be shown later, do not seriously affect the results obtained. Copper tubes having dimensions as shown in Table I were used. The tubes were formed into coils free from sharp bends, dents, etc.

The experimental curves, together with curves calculated as described below, are shown in Figs. 1 to 6 inclusive.

Formulas for Determining Fluid Flow

Various formulas for calculating pressure drop have been proposed, several of which have been discussed by Linebaugh [1] and Stickney [2]. Examination indicated that the formula suggested by Walker, Lewis and McAdams [4] should be capable of modification to a relatively simple form for refrigeration use and this was found to be the case. As given, the equation has the form:

$$\Delta P = \frac{2 f L P u^2}{gd}$$ where,

f = Friction factor, no units.
L = Length of straight pipe, in feet plus equivalent length due to bends, valves, etc.

TABLE I. PIPE SIZES USED IN FIGS. 1-6

OUTSIDE DIAMETER INCHES	WALL THICKNESS INCHES	INTERNAL DIAMETER INCHES
½	.032	.436
⅝	.040	.545
¾	.042	.666
⅞	.045	.785
1⅛	.050	1.025
1⅜	.055	1.265
1⅝	.060	1.505
2⅛	.070	1.985

[1] Refrigerating Engineering *26*, 82 (1933).
[2] Refrigerating Engineering *35*, 261 (1938).
[3] Refrigeration Service Engineer Aug. p. 34, Sept. p. 16, Oct. p. 32, Nov. p. 32, Dec. p. 24 (1937)
*Present address: Regulator Division, Square D Co., Detroit, Mich. Paper presented by Geo. H. Clark at fifth annual R.S.E.S. Convention, Buffalo, N. Y.

[4] Principles of Chemical Engineering, Second Ed. p. 87 (McGraw-Hill).

TABLE II. FRICTION FACTORS

F	f	F	f	F	f
.14 — .16	.014	1.80 — 1.89	.0072	15.1— 17.5	.0043
.17 — .20	.0135	1.90 — 2.05	.0071	17.6— 20.0	.0042
.21 — .26	.013	2.06 — 2.25	.0070	20.1— 22.0	.0041
.27 — .33	.0125	2.26 — 2.40	.0069	22.1— 24.5	.0040
.34 — .37	.012	2.41 — 2.50	.0068	24.6— 26.5	.0039
.38 — .40	.0115	2.51 — 2.60	.0067	26.6— 33.0	.0038
.41 — .43	.011	2.61 — 2.75	.0066	33.1— 37.0	.0037
.44 — .46	.0105	2.76 — 2.95	.0065	37.1— 41.0	.0036
.47 — .54	.010	2.96 — 3.20	.0064	41.0— 47.0	.0035
.55 — .58	.00975	3.21 — 3.40	.0063	47.1— 51.0	.0034
.59 — .68	.0095	3.41 — 3.55	.0062	*52. — 70.	.0033
.69 — .72	.00925	3.56 — 3.75	.0061	71. — 78.	.0032
.73 — .82	.0090	3.76 — 4.10	.0060	79. — 85.	.0031
.83 — .86	.0089	4.11 — 4.25	.0059	86. —105.	.0030
.87 — .89	.0088	4.26 — 4.50	.00585	106. —120.	.0029
.90 — .92	.0087	4.51 — 4.75	.0058	121. —140.	.0028
.93 — .95	.0086	4.76 — 5.00	.0057	140. —210.	.0027
.96 — .97	.0085	5.00 — 5.30	.0056		
.98 —1.05	.0084	5.31 — 5.70	.0055		
1.06 —1.14	.0083	5.71 — 6.10	.0054		
1.15 —1.20	.0082	6.11 — 6.50	.0053		
1.21 —1.24	.0081	6.51 — 7.05	.0052		
1.25 —1.35	.0080	7.06 — 7.50	.0051		
1.36 —1.42	.0079	7.51 — 8.10	.0050		
1.43 —1.47	.0078	8.11 — 8.80	.0049		
1.48 —1.53	.0077	8.81 — 9.50	.0048		
1.54 —1.61	.0076	9.51 —11.0	.0047		
1.62 —1.68	.0075	11.1 —12.0	.0046		
1.69 —1.74	.0074	12.1 —13.2	.0045		
1.75 —1.79	.0073	13.3 —15.0	.0044		

* Extrapolated beyond this point.

P = Fluid density in lb. per cu. ft. = 62.3 × (S).

u = Average velocity of the fluid in ft. per sec. = $\frac{\text{Discharge as cu. ft. per second}}{\text{Cross section in sq. ft.}}$

g = 32.2 feet per sec. per sec.

d = Actual inside diameter in feet.

P = Pressure drop in lb. per sq. ft.

D = Actual inside diameter in inches

s = Specific gravity, no units

z = Viscosity relative to water at 68 degrees F. (centipoises).

The term "f" is determined from a graph plotted in terms of the factor $\frac{Dus}{z}$ (which for convenience we will refer to as F).

Table II presents the values of "f" for various pertinent values of F.

For calculating pressure drop in refrigerant gas lines, the formula may be adapted to the form:

$$\Delta P = \frac{194{,}000\ f\ T^2 V}{D^5\ H^2}$$

and the F term reduced to $\frac{9.793\ T}{Z\ D\ H}$

where T = refrigeration capacity in tons

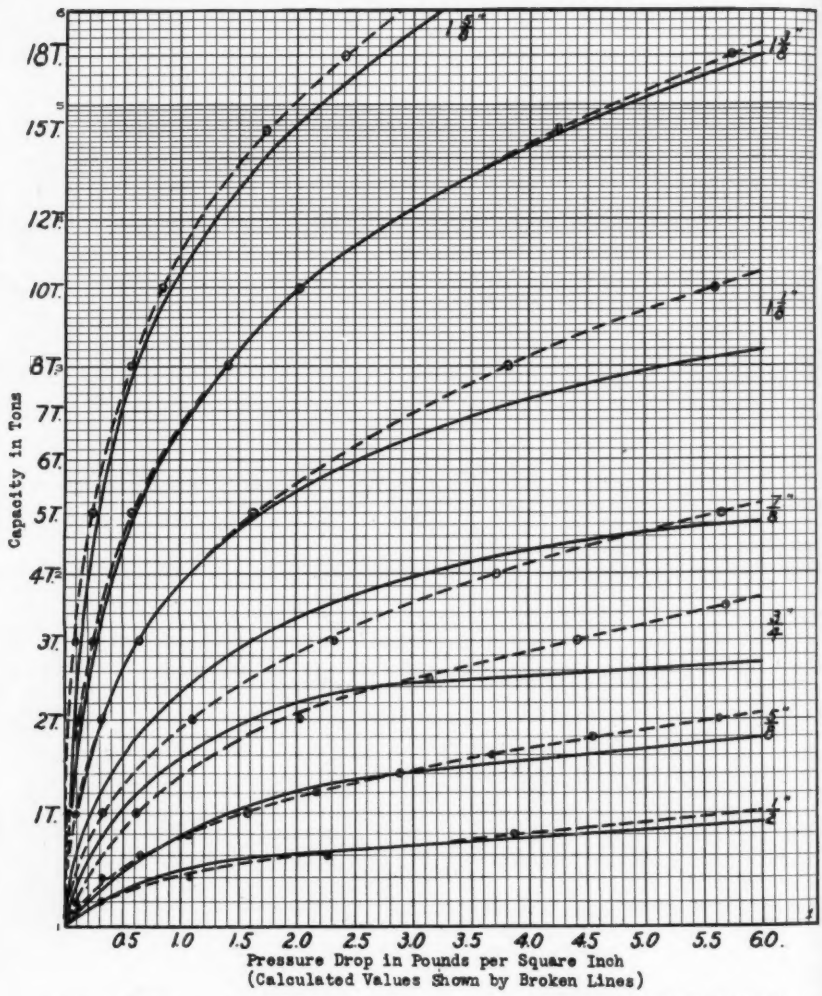
V = cu. ft. per lb. of the gas passing through the pipe.

H = effective refrigeration in B.t.u. per lb.

A sample calculation for methyl chloride follows:

Gas evaporated at 0 degrees and super-

Fig. 1.—Pressure Drop in Methyl Chloride Suction Lines
Per 100 ft. Length
40° Evaporating Temperature—90° Liquid to Valve—65° Gas in Lines



heated to 65 degrees = 207.8 Btu per lb.
90 degrees liquid... = 48.0 Btu per lb.

Effective refrigeration
per lb. ..... = 159.8 Btu per lb.

Then for three tons of refrigeration in the 1⅛ inch pipe, the F term becomes

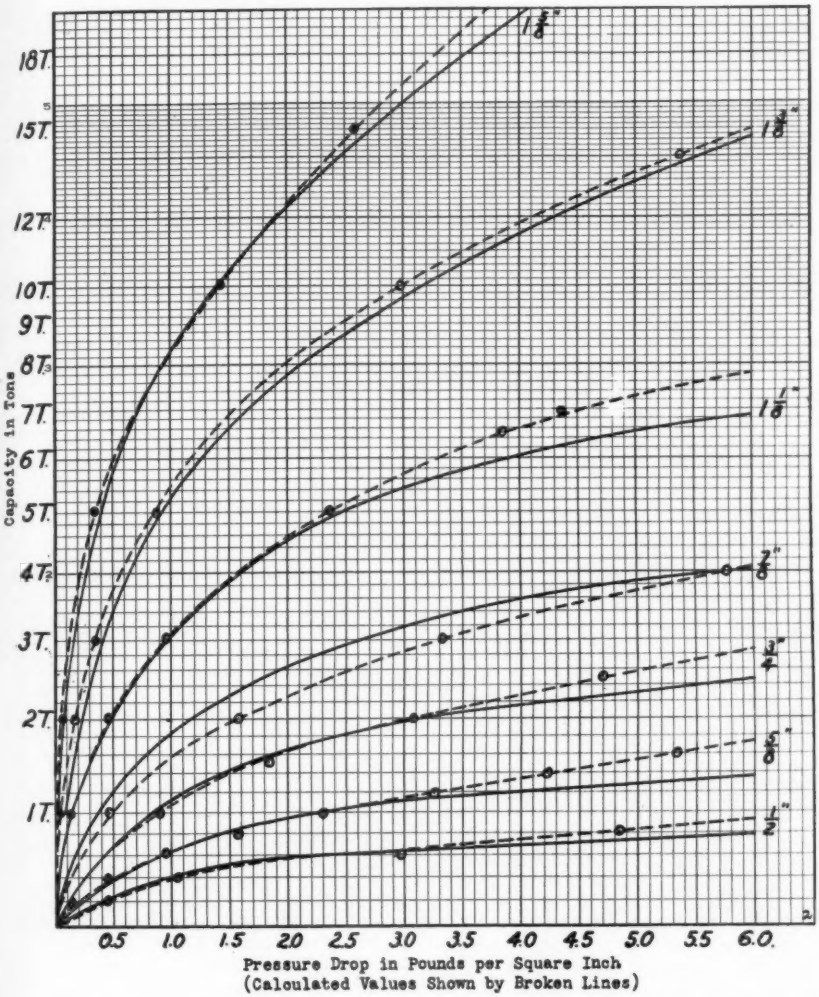
$$\frac{9.793 \times 3}{.0108 \times 1.025 \times 159.8} = 16.6;\ f = .0043;$$

and $$P = \frac{194{,}000 \times .0043 \times 3^2 \times 5.74}{1.025^5 \times (159.8)^2} =$$

1.49 lbs. per sq. in.

In this case, since the calorimeter acted as both evaporator and superheater, the heat used to superheat the gas is included. In the usual calculations, the superheat energy would not be included.

Fig. 2.—Pressure Drop in Methyl Chloride Suction Lines
Per 100 ft. Length
20° Evaporating Temperature—90° Liquid to Valve—65° Gas in Lines



The heat values [5] given do not check latest data but are used because later tables do not include superheat data. However, the differential value is believed to be accurate.

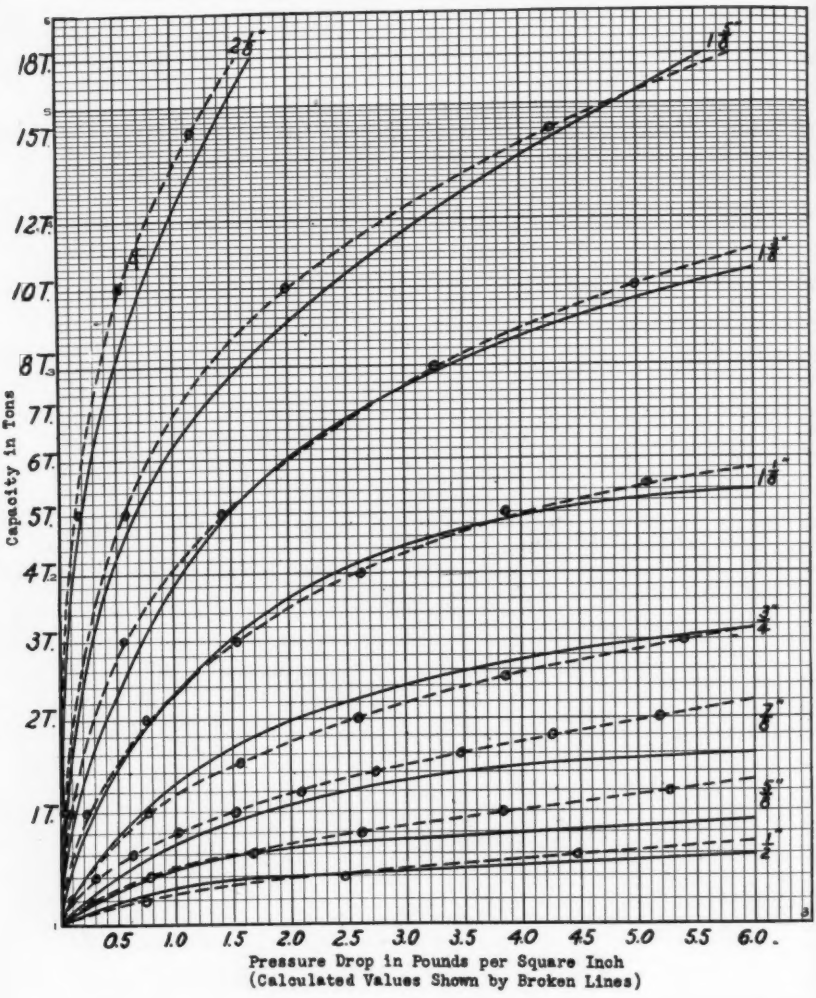
The volume of the superheated vapor under these conditions has been interpolated from tables [5] and found to be 5.74 cu. ft. per lb. Viscosity data for Methyl Chloride and Sulphur Dioxide was taken from the A.S.R.E. Data Book, Third Edition. Data for "Freon-12" were secured from the manufacturers.

[5] A.S.R.E. Data Book, First Edition.

Comparison of Experimental and Calculated Values

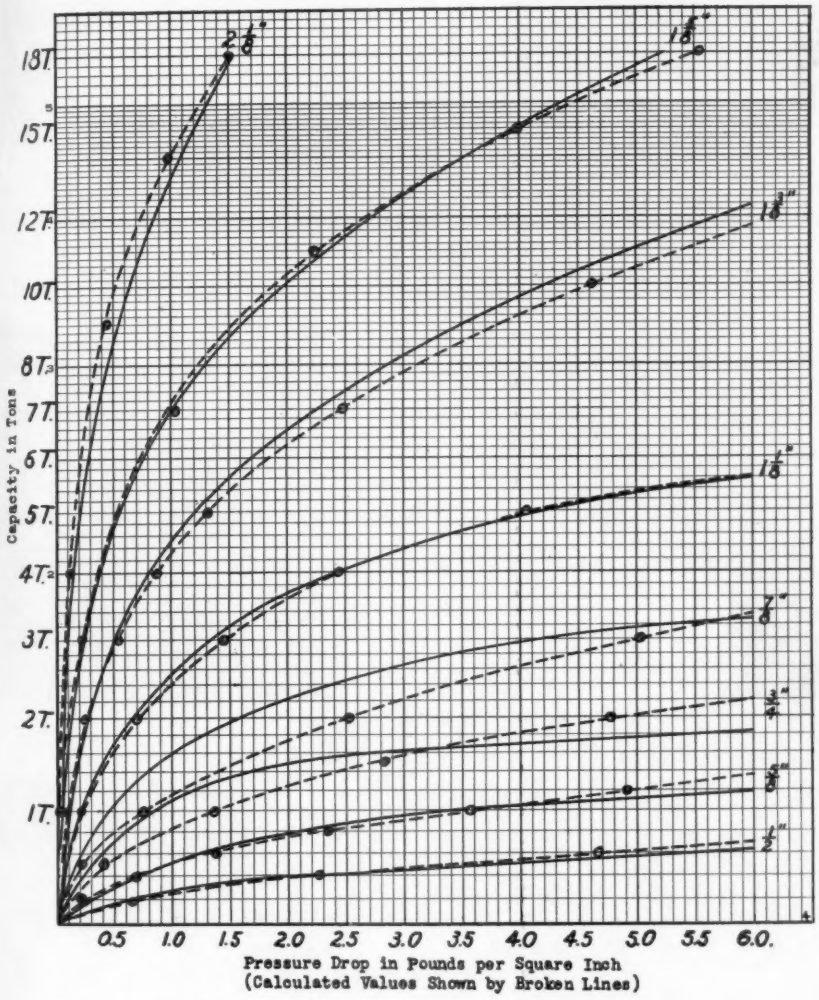
The calculated curves shown in Figs. 1

Fig. 3.—Pressure Drop in Methyl Chloride Suction Lines
Per 100 ft. Length
0° Evaporating Temperature—90° Liquid to Valve—65° Gas in Lines



to 6 can be secured by use of the equation. As the curves indicate, the agreement between experimental and calculated values is satisfactory in most cases. Where small pipes and large tonnages are involved the experimental value is greater than the calculated, probably due to the increasingly great effect of oil on the walls as the diameter becomes smaller as well as to the pressure drop in producing the necessary velocity head. Variation in test conditions may account for some minor discrepancies between the two values. Also, difficulty in reading the values of "f" from the graph[4], together with minor slide rule errors, etc., in calculation, may readily account for as much as 3 per cent error in the values given. Uncertainties in data for Methyl Chloride

Fig. 4.—Pressure Drop in "Freon-12" Suction Lines
Per 100 ft. Length
40° Evaporating Temperature—90° Liquid to Valve—65° Gas in Lines



may introduce errors of unknown magnitude. However, as the curves indicate, the calculated and experimental data in general check satisfactorily within the limits of practical importance.

When the experimental and calculated data were found to check satisfactorily, it occurred to the authors that the pressure drop information might be extended, modified and listed in tabular form for convenience as in Table III. It should be noted that values are given for actual inside diameters rather than for pipe sizes. For actual pipes, the pressure drop may be readily estimated. The data is of course given for drawn copper pipe or its equivalent. Data for iron pipe could be calculated if desired by reference to the original equation in

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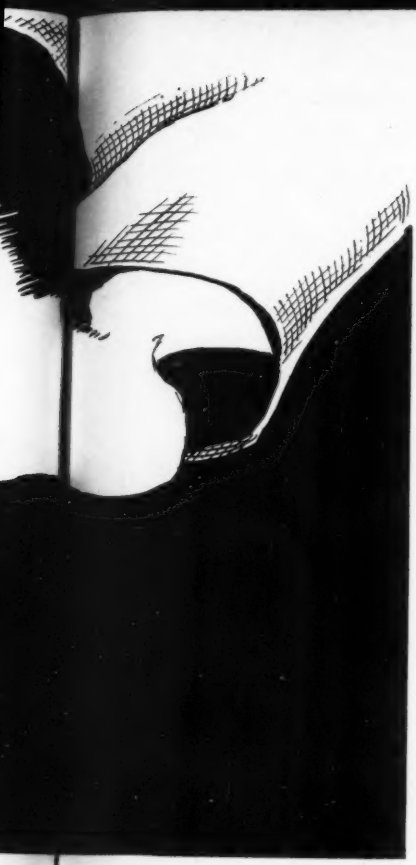

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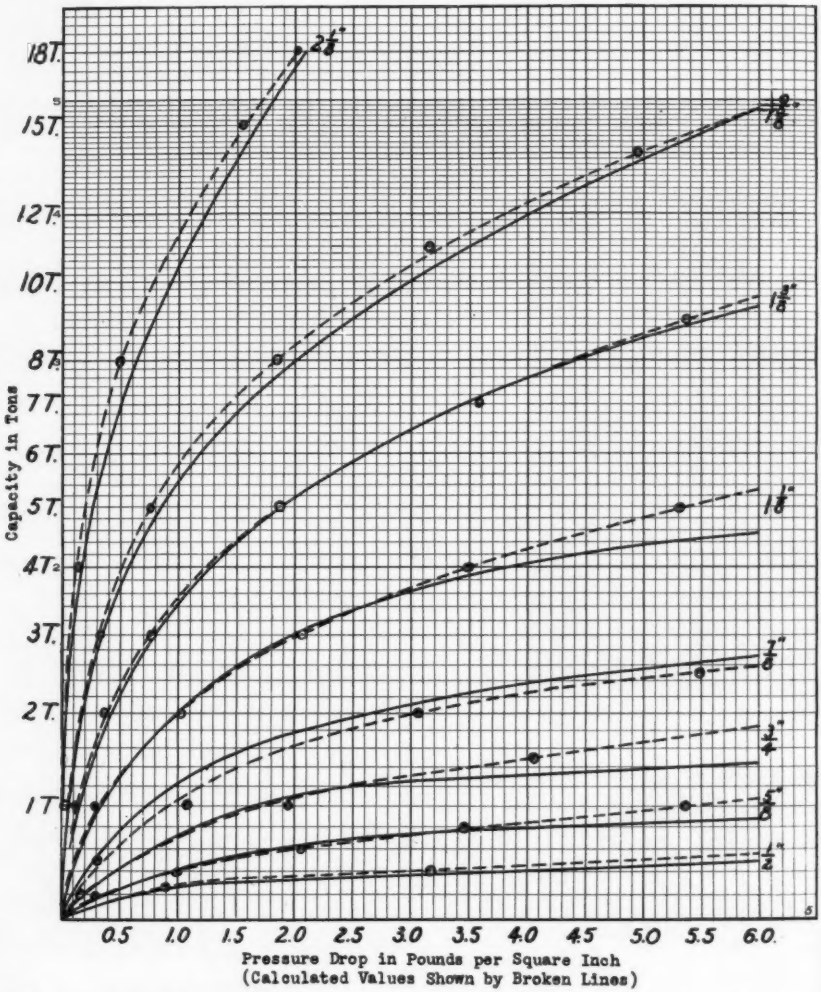
Fig. 5.—Pressure Drop in "Freon-12" Suction Lines
Per 100 ft. Length
20° Evaporating Temperature—90° Liquid to Valve—65° Gas in Lines



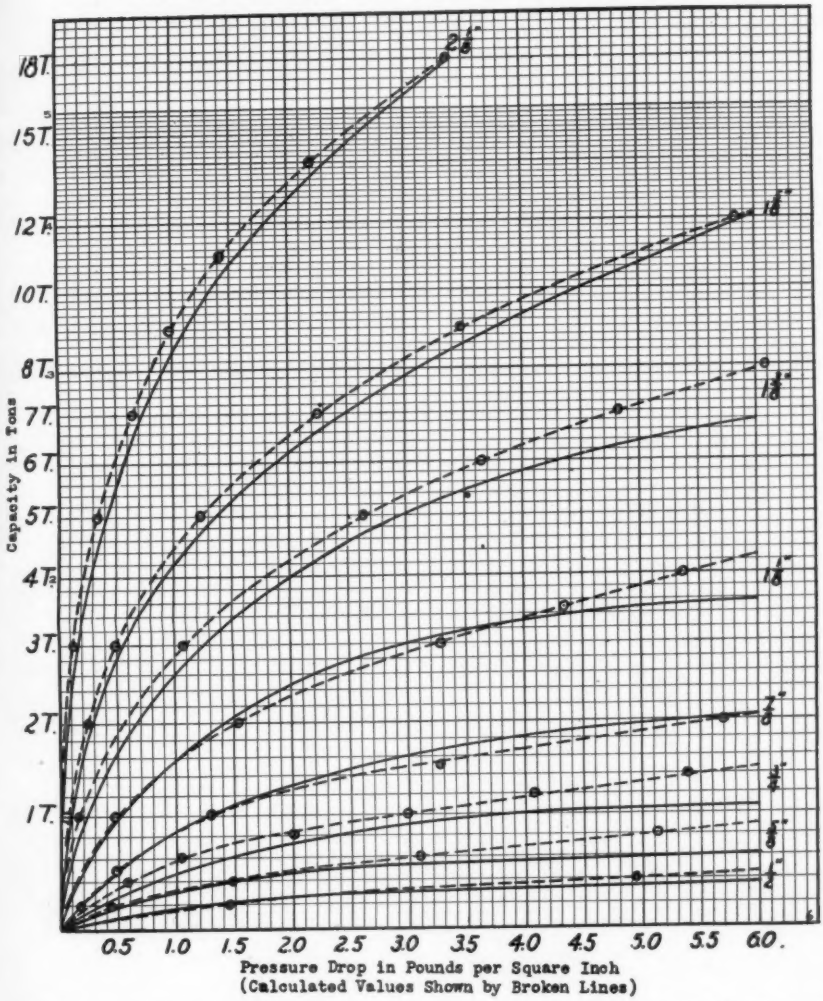
Walker, Lewis and McAdams' book [4].

It was believed that pressure drop in SO_2 suction lines should be capable of similar calculation by this method. Values for SO_2 have been so obtained which appear reasonable and are included although no experimental work has been done to verify the calculated values.

The values for Methyl Chloride and "Freon-12" have been carried to higher tonnages and larger pipe sizes than were used experimentally and are thus unverified in these regions.

Values for the pressure drop at 40 degrees evaporation temperature were calculated by means of the simplified formulas above. Since variation in evaporation temperature affects mainly the V term in the equation,

Fig. 6.—Pressure Drop in "Freon-12" Suction Lines
Per 100 ft. Length
0° Evaporating Temperature—90° Liquid to Valve—65° Gas in Lines



multiplying factors related to volume changes may be used with satisfactory practical accuracy for calculating pressure drop at other temperatures when the pressure drop for 40 degrees F. evaporation is known. Thus, for a given pipe and tonnage the pressure drop may be determined quite accurately for 20 degrees evaporation by multiplying the pressure drop as calculated for 40 degrees evaporation by 1.60 for SO_2, 1.56 for Methyl Chloride or 1.54 for "Freon-12." For 0 degrees F. evaporation, the factors are 2.70, 2.51 and 2.70 and for —20 degrees F. evaporation, 4.88, 4.28 and 4.48 for SO_2, Methyl Chloride and "Freon-12" respectively. These factors, rather than the more complicated formulas, were used in calculating the corresponding data in Table III, the figures

TABLE III- PRESSURE DROP IN SUCTION LINES

Lbs. Per Sq. In. Per 100 Feet - 60° Liquid To Valve, 60° Gas In Lines

Actual I.D. of Tube Inches	Temp. °F.	Tons of Refrigeration - Methyl Chloride, Sulphur Dioxide, Freon (F-12)																											
		1/4			1/2			1			2			3			5			10			16			20			30	
		H	S	F	H	S	F	H	S	F	H	S	F	H	S	F	H	S	F	H	S	F	H	S	F	H	S	F	H	S	F
5/16	40°	2.4	3.7	4.7	7.7	12.3	17.1																								
	20°	3.7	5.9	7.2																											
	0°	5.9	10.0	12.7																											
	-20°	10.6	18.1	21.1																											
7/16	40°	.4	.7	.9	1.5	2.4	3.5	5.2	8.3	12.3																					
	20°	.7	1.2	1.4	2.3	3.8	5.4																								
	0°	1.1	1.9	2.4	3.8	6.5	8.4																								
	-20°	1.9	3.5	4.0	6.4	11.7	15.7																								
9/16	40°	.1	.2	.3	.5	.8	1.0	1.6	2.5	3.6	5.6	9.0	12.2	11.6	18.1	25.0															
	20°	.2	.4	.5	.9	1.2	1.6	2.5	4.0	5.5																					
	0°	.4	.6	.8	1.2	2.0	2.8	4.0	6.9	9.7																					
	-20°	.6	1.1	2.1	2.1	3.2	4.7	6.9	12.2	16.1																					
3/4	40°	.0	.1	.1	.1	.2	.5	.4	.6	.9	1.4	2.2	3.1	2.9	4.5	6.2	7.4	11.5	15.9												
	20°	.1	.1	.1	.2	.3	.7	.6	1.0	1.4	2.2	3.5	4.8	4.5	7.2	9.5	11.5	18.1													
	0°	.1	.2	.2	.3	.5	1.3	1.0	1.7	2.4	3.5	5.9	8.4	7.3	12.2	16.7	18.6														
	-20°	.2	.3	.3	.5	.9	2.1	1.8	3.0	4.0	6.0	10.7	13.9	12.4	22.0	27.8															
1	40°				.1	.2	.2	.4	.5	.8	.7	1.1	1.6	1.9	2.8	4.3	0.3	0.9	14.1	15.1	20.2	29.1	21.9	32.9	47.4						
	20°				.1	.3	.4	.6	.9	1.2	1.2	1.8	2.5	2.8	4.5	6.6															
	0°				.2	.3	.6	.9	1.5	2.2	1.9	3.1	4.4	4.5	7.6	11.6															
	-20°				.3	.4	1.0	1.6	2.6	3.6	3.1	5.6	7.3	7.7	14.1	19.3															
1¼	40°							.1	.1	.1	.1	.2	.2	.3	.4	.6	.9	1.4	2.0	1.9	2.9	4.1	3.2	4.9	6.2	6.5	10.0	14.6			
	20°							.1	.1	.3	.2	.3	.4	.4	.6	.9	1.4	2.3	3.1	2.9	4.6	6.2	5.0	7.6	9.5	10.2	16.0				
	0°							.1	.2	.3	.3	.4	.7	.7	1.1	1.5	2.3	3.5	5.4	4.8	7.9	11.0	8.0	13.2	16.7	16.3					
	-20°							.2	.4	.5	.6	.8	1.1	1.1	1.9	2.6	3.9	6.0	6.9	6.1	14.2	18.2	13.7	24.0	27.9						
2	40°										.1	.1	.3	.2	.3	.4	.6	.7	1.0	.6	.7	1.0	.7	1.4	1.9	1.7	2.5	3.8			
	20°										.1	.2	.3	.3	.4	.6	.8	1.2	1.6	1.2	1.8	2.6	1.1	2.2	2.9	2.6	4.1	5.9			
	0°										.2	.3	.4	.4	.6	1.0	1.4	2.0	2.8	1.8	3.0	4.9	1.8	3.9	4.9	4.1	6.9	10.2			
	-20°										.3	.5	.7	.6	1.0	1.5	2.0	3.4	4.6	3.1	6.5	8.2	3.1	6.8	8.2	7.1	12.4	16.8			
2½	40°										.1	.1	.3	.2	.3	.4	.6	.8	1.2	.8	.9	1.4	.9	1.7	2.3	.9	1.4	2.0			
	20°										.1	.2	.3	.3	.4	.6	.8	1.2	1.6	1.1	1.8	2.6	1.4	2.7	3.4	1.5	2.4	3.4			
	0°										.2	.3	.4	.4	.6	.9	1.2	1.8	2.4	1.6	2.7	3.7	2.1	4.0	5.1	2.5	4.2	5.7			
	-20°										.3	.5	.7	.6	1.0	1.4	1.8	3.0	4.0	2.8	5.7	7.2	3.7	7.0	8.9	4.4	7.4	10.0			
3	40°													.1	.2	.3	.4	.6	.8	.5	.7	1.0	.6	1.1	1.4	.7	1.1	1.5			
	20°													.2	.3	.4	.6	.8	1.1	.8	1.2	1.6	.9	1.7	2.1	1.1	1.7	2.3			
	0°													.2	.4	.6	.8	1.2	1.6	1.2	1.8	2.4	1.4	2.6	3.2	1.6	2.6	3.5			
	-20°													.3	.5	.7	1.2	1.8	2.4	1.7	2.7	3.6	2.1	3.9	4.8	2.4	3.9	5.2			
4	40°																.1	.2	.3	.2	.3	.4	.2	.4	.5	.3	.4	.6	.1	.1	.2
	20°																.2	.3	.4	.3	.4	.6	.3	.6	.7	.4	.6	.8	.1	.2	.3
	0°																.2	.4	.5	.4	.6	.8	.4	.8	1.0	.5	.8	1.1	.2	.3	.4
	-20°																.3	.5	.7	.5	.8	1.1	.6	1.1	1.4	.7	1.1	1.5	.3	.4	.6

being abbreviated to one decimal place after calculation.

The effects of change in liquid temperature and suction gas temperature are smaller than those due to change in evaporation temperatures and pressure drop under various conditions may be determined with reasonable accuracy from the values given in Table III by means of the following corrections:

For 10 degrees increase in liquid temperature, $\triangle$ P is about 5 percent greater for SO_2 and Methyl Chloride, 10 percent greater for "Freon-12."

For 10 degrees increase in temperature of the superheated suction gas, $\triangle$ P is about 2 percent greater for the three refrigerants.

For greatest accuracy, the simplified formula should be used in all cases.

Assumptions Used in Calculations

It should be noted that in Table III, values are calculated on the assumption that saturated gas leaves the evaporator. If the gas superheats in the evaporator, added refrigeration equivalent to the superheat will be secured, in which case the pressure drop will be slightly less than the value given. This variation will in general be of the order of only a percent or two and of little value in determining pipe size. It may be taken into account if desired by using the heat content of the gas at the given superheated condition in calculating the effective refrigeration per pound.

It is also to be noted that values in Table III are based on a constant temperature of 60 degrees in the suction line. In the actual installation having no heat interchanger, gas leaving the evaporator in a saturated or slightly superheated condition will warm up in the suction line. The cold gas thus entering the suction line will have a smaller volume, the V term will be smaller and hence the pressure drop in the line will be less than for the case where the gas is at a temperature of 60 degrees F. throughout the pipe.

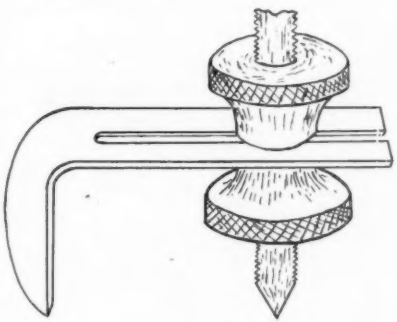
Since the volume of the gas will be very nearly in the ratio of the absolute temperatures, gas having a pressure drop of 1 pound with 60 degree gas would have a drop of only about .9 pound for 10 degree gas, provided the gas remained at 10 degrees throughout the suction line. Since the gas will ordinarily rise in temperature in the suction line and the superheating occur over varying proportions of the suction line, the effect is not large, probably never over 5 percent, and it is believed that this factor may well be omitted in most cases and the higher value used to give a slight margin of safety.

Experimental tests on pressure drop in liquid lines are being carried on at present and it is hoped that this material may be made available in the near future.

GASKET CUTTER

HERE is a simple easily made little tool that will be found useful for making circular cuts in leather, sheet rubber and gasket materials.

Grind a 3/16 or 1/4-inch bolt to a sharp point at the thread end, and cut the head off the other end. Provide this bolt with two knurled or hexagon nuts.



Make the blade of a piece of hack saw blade by heating and removing the temper. Then, shape as shown with a sharp pointed knife edge on the right angle portion.

After the proper shape has been obtained, heat the blade to a cherry red and plunge in water to restore the temper.

The cutter may be used by hand, or in conjunction with a hand or power drill.

Charles Dean,
Idaho.

Enclosed please find a money order for $2.00 for THE REFRIGERATION SERVICE ENGINEER for the coming year. It is a fine magazine, and I read it every month. I especially like the Question Box and service data on new models.

Howe Utility Freezer

By H. B. HOWE *

JUST about the time that we begin to think that our commercial refrigeration work is just so much daily routine, along comes some fellow who has worked his gray matter overtime, with the result that a new idea has been born, and with proper nourishment, it develops into a healthy child.

You and I both know that the average meat market goes along in about the same old way. Yes, it is true that Mr. Market Owner has dressed up his store, giving it more eye appeal, installed modern display cases that keep meat products in a salable condition for longer periods of time, and along with these changes the refrigeration man has done his bit to produce conditions that result in ideal cooling for meat products.

Proper cooling, humidity and air circulation control have reduced the losses of the retail market man to a minimum, so we, in the refrigeration industry, can pat ourselves on the back and say that we are the fellows who help make it possible for the butcher to have more money in the cash register on Saturday night.

We have cut the losses and improved the keeping quality of all meat products in the last decade with modern engineering, but there is still one place where the leak has not been stopped. What will the butcher do with poultry that is left over on Saturday night or surplus fish on Friday or how can he cut the excessive losses that he is experiencing with perishable items, such as brains, sweetbreads, liver, oysters, etc.? The answer is to install the Utility Freezer inside the walk-in cooler.

The Howe Utility Freezer which is designed for installation inside the walk in cooler.

Our Company has learned that every retail market owner not only needs, but wants

* President—Howe Ice Machine Company, Chicago.

one of these units and for a very modest investment a Utility Freezer can be installed.

Experience has taught us that three different sizes of units are required to take care of markets of various sizes—namely units having storage capacity of 8, 12 and 16 cubic feet. These units are fabricated from galvanized sheet metal, both inside and outside, and insulated with 3 inches of cork board throughout. Substantial hardware is used and the door is provided with double gasketing.

The cooling surface consists of 1-inch steel pipe arranged in the form of shelves, continuously bent and welded and hot galvanized after fabrication. This type of cooling coil permits the use of any refrigerant.

Showing the Utility Freezer in actual use.

This Utility Freezer is connected into the existing refrigeration system and the method of installation depends upon the type of refrigeration plant. We will take first the ammonia plant:

In this case, the serviceman arranges to pump down the low side so that the liquid line can be broken into somewhere between the king valve on the receiver and the thermo expans'on or automatic expansion valve; re-install the thermostatic or automatic expansion valve on the bottom or inlet connection of the Freezer. The outlet, or top connection, will be connected to the existing cooling coils. This type of hook-up will place the Utility Freezer in series with the present coils and will not require any extra controls or valves. The setting of the thermostat for maintaining proper temperature in the walk-in cooler will be left as is and the temperature in the Freezer will always be below the freezing point.

When installed in combination with an existing methyl or Freon plant the hook-up is a little more complicated. Experience recommends the following arrangement:

Install a thermostatic valve on the Utility Freezer coil, which will be separate from the thermostatic valve on the cooler coils or counter coils. This thermostatic valve should feed into the bottom or low point of the coil and the suction return taken off at the top. In the suction line from the Freezer install a check valve to prevent the return gas from the cooler coils condensing in the Freezer coils. A constant pressure valve should then be installed in the suction line from cooler and counter coils in order to maintain higher suction pressure and corresponding higher refrigerant temperature at this point. The last adjustment is to change the pressure control on the compressor so that the kick-out point for stopping the compressor will correspond to the proper temperature to maintain 15 degrees F. temperature in the Utility Freezer.

The above type of hook-up will furnish positive temperature control in both Freezer and cooler.

Regardless of whether the paint is ammonia, methyl or Freon, the installation can be handled by a refrigeration serviceman and a little sales effort on his part will net a nice profit from both labor and sales. Promoting the sale of this type of equipment to the retail market owner is an excellent good-will builder, and you will agree that there never has been a time in the history of business when the building of good-will is so essential as today.

S S S

Don Kuhl,
Oregon

May I say your publication is one of the finest I have seen, and I wish I had all the back copies.

Fred Herbst, Jr.,
Wisconsin.

Yours is the best paper for the money any refrigeration engineer and serviceman can get, that I have seen.

Art Nichols,
Ohio

We think a lot of your magazine, as it has helped us out of some pretty tough problems.

Contest Closes December 31

for best suggestions on

Service "Kink" or Tool

The Refrigeration Service Engineer is sponsoring this contest in the interests of promoting shorter and better service methods. All those actively engaged in the Service of Electric Refrigeration are invited to participate.

The first announcement of this Contest was made in the October issue of this journal, but as a reminder to those who may have forgotten, we are repeating it here.

Several fine contributions have been received so far, but we are convinced there are many more of a prize-winning nature yet to come.

Remember that no matter how large or how small, how complicated or how simple the device or method is, it may win a prize. It is its usefulness and originality that count.

OCCASIONALLY in past issues of THE REFRIGERATION SERVICE ENGINEER articles have appeared describing the use and construction of tools or equipment which can be made in the average shop and used in the service field. Other articles have described short-cut methods in service operations and useful service "kinks."

Examples of these articles have appeared in THE REFRIGERATION SERVICE ENGINEER, under the titles and dates following:

"Cotter Pin Extractor and Speed Reamer"—page 29, July, 1938

"Building an On and Off Recorder"—page 13, June, 1938

"Better Rotor Lubrication"—page 32, July, 1937

Because it is our belief that there are many such tools and kinks in use by the individual readers of this journal, which would be interesting to other readers, we will conduct a contest, beginning November 1, 1938, and ending December 31, 1938, for the best articles submitted on these subjects.

Cash awards for the best stories will be made as follows:

For the best article submitted.....$25.00
For the second best article..... 10.00
For the next three best articles—each 5.00
For each additional article acceptable for publication..... 2.00

If you are using a tool or piece of test equipment which you made in your shop and which you feel could be used by others, or if you know of some "service tip" which will save time and trouble, write us a letter, describing it in your own way, with as much detail as possible, so that it will be thoroughly understood. If you can supply clear sketches, or photographs, which can be used as illustrations, send them along, also. They help to clarify a description more than all the writing you can do.

Rules of the Contest

1. All entries must be postmarked before midnight, December 31, 1938.
2. Judges of the contest will be Mr. Geo. H. Clark, Detroit, Mich., Mr. Paul Jacobsen, Marion, Ind., and Mr. Harry D. Busby, Associate Editor, REFRIGERATION SERVICE ENGINEER. Their decisions will be final.
3. Candidates may enter one or more letters, as they see fit.
4. Employees of Nickerson & Collins Co., or regularly contributing editors to THE REFRIGERATION SERVICE ENGINEER, will not be considered eligible for this contest.
5. Letters will be judged on the usefulness, originality, clarity of description and illustration of the device described. Good English, spelling or composition will not be considered in the contest.
6. All entries become the property of Nickerson & Collins Co., and are not returnable, whether used for publication or not.
7. Full credit will be given the author of each letter published.

A Running Time Indicator

Though two articles have been published prior to this on such devices, this is the simplest method of them all in doing this particular job.

By ED. McDONALD

THE title of this article indicates that this device records the running time of the refrigerator. The fact is that only the idle time is recorded. Due to the nature of the device and its simplicity, this is all it is capable of doing, but from the information it will give, the running time may be calculated.

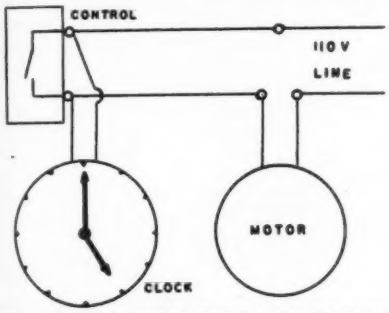


FIG. 1. A POINT TO POINT DIAGRAM OF THE HOOKUP.

The equipment consists of nothing more than a self-starting electric clock, which if you wish, may be equipped with two metal clips on the line leading to it, so that connection to the refrigerator electric circuit may be more easily made.

Fig. 1 is a point-to-point diagram, showing the manner of connecting the clock in the circuit. Simply connect it in parallel to the thermostat or pressure control, or in other words, across the line going to the control. It may be connected at any point convenient to reach, such as at the motor where the control, motor and line connections are made, or at the control binding posts themselves.

In operation, the circuit works as follows, which is more clearly illustrated in Fig. 2. When the control switch is in, the current passes through it to the motor and the machine runs, but the clock stops. When the switch is open, the motor stops and the current passes through the clock and through the motor, completing the circuit. The clock starts and continues to run until the switch again closes.

In practice, the clock can be used as follows: We will connect our clock at 5 p.m. and set both hands exactly at 12. The following day, we will take a reading of our clock at 9 a.m., a lapse of 16 hours since setting it. We find our clock reads 10:30, which indicates that our machine has had a total of 10½ idle hours out of 16, or that it has run a total of $16 - 10\frac{1}{2} = 5\frac{1}{2}$ hours out of 16.

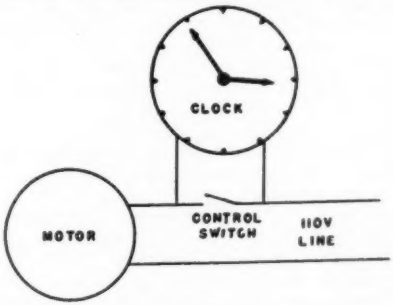


FIG. 2. A SCHEMATIC DIAGRAM WHICH SHOWS THE OPERATION OF THE CIRCUIT MORE CLEARLY.

S S S

F. J. Lopez
Nevada

I received my first copy of REFRIGERATION SERVICE ENGINEER. It is the best magazine I have seen. It is full of good information. Sorry I did not hear of this before. You can count me as one of your regular subscribers from now on.

Garland Tomlin
Georgia

First off, let us get rid of our earnest desire to hand you a bouquet. Your publication is the best ever. We feel like it is indispensable in our refrigeration department.

The Question Box

Readers are invited to send their problems pertaining to the servicing of household refrigerators and small commercial refrigerating equipment as well as oil burners to "The Question Box."

MOISTURE PROBLEMS, TIGHT COMPRESSORS, HIGHSIDE FLOATS, LOCATION OF EVAPORATOR

QUESTION 287. (1) When a domestic refrigerator is pumped down, for example, to replace a highside float, the entire gas charge being pumped out, do you believe it is satisfactory, when the equipment is assembled, to just pump a vacuum on the entire system and let it remain long enough to determine if any leaks are present, then if a vacuum remains constant, charge the system with the proper amount of refrigerant? Do you believe the unit being open, say under average conditions, there would be enough moisture left in the system to cause any harm after pumping a vacuum of 27 inches? I am anxious to know if any other method is used. Please explain this fairly thoroughly. This should also hold good for domestic installations, should it not? I am considering the system dry before being opened.

(2) Where would you say to put a dehydrator and a strainer in a highside float system, or a lowside float system?

(3) A compressor squeaks when the flywheel is turned by hand and operates hard. Is that an indication of air being taken in at the seal, causing carbon and damage to the seal due to loss of oil?

(4) Due to the writing and explanations of moisture present in oil used to service a compressor, it appears to me that it is impossible for a serviceman to overcome this. A gallon can of oil will service about four to six domestic compressors. Each time the can is opened, air enters the can, but this same can, with the rest of the oil, is used for other oil changes. Now is there enough moisture entering to cause a stick-up?

(5) What do you think of the idea of replacing a highside float with an automatic expansion valve, or a thermostatic expansion valve? On a Kelvinator using a check valve at the evaporator, would it be removed and the expansion valve installed in its place?

(6) Where do you believe the best results are obtained—by placing an evaporator in the center of the refrigerator, or over against the side?

ANSWER: (1) In service problems requiring the opening of a system to the air, little difficulty is ever experienced, to my knowledge, due to the entry of moisture if ordinary precautions are taken, and if the weather conditions are of the average.

I might say here that greater precautions have to be taken during periods in which the humidity is very high. In Chicago, for instance, during the first three months of each year, we often have very damp, rainy weather, which is decidedly detrimental to refrigerating machines that might be opened at that time. I have never heard of the condition causing the machine to become stuck-up, however, if ordinary precautions are taken.

These precautions, I would say, should include such things as: warming up the parts, or the entire system for that matter, to a temperature nearly to, or above, the room temperature before the system is opened; that a slight pressure of say ½ lb. gauge pressure be left in the system before it is opened so that no air will be sucked in.

After the part is removed, openings in the system should be capped until such time as you are ready to replace the part. The ordinary procedure then, of course, will be as you explained, in pumping a vacuum of 27 inches, or whatever you may be able to obtain, and then I believe a further precaution should include a purging of the lines of the entire system wherever this is possible. This procedure, of course, will apply to both commercial and domestic units.

The changing of highside floats is not nearly as dangerous from this viewpoint as that of changing lowside floats, since some part of the system in the lowside will usually be cold, and air entering it will condense out the moisture immediately upon striking the cold parts.

(2) A strainer should not be considered

as a part of the dehydrator, since they are two separate devices, and should not be used to do the job of both, even though the dehydrator usually incorporates a strainer. I would say that the strainer should always be placed in the liquid line, while a dehydrator may be placed in either, depending on the gas used, the dehydrating agent used, and the circumstances of the installation. I would refer you to the article appearing in the March, 1938 issue of THE REFRIGERATION SERVICE ENGINEER, entitled, "Refrigerant Driers." I believe this will explain your question more thoroughly than I can.

(3) A compressor that squeaks and turns hard may be due to one of two causes. The squeaking may be due to a dry seal, or perhaps to dry bearings through a lack of oil, or the combined condition may be due, as you suggested, to an entry of moisture and the subsequent development of carbon, which is binding the compressor.

(4) The amount of moisture that would enter oil during the process of pouring it from a can, and due to the air entering the can at this time, would not be sufficient to cause the machine to stick-up, but will, of course, cause a certain amount of corrosion at various parts of the compressor and liquid control. It is true that it is difficult for the serviceman to entirely overcome this condition in handling the oil. The recommended method, though, is to install a refrigerant drier such as the calcium chloride type, in the vent of the can, so that all air taken into it while pouring the oil will have to go through the drier. This drier, of course, would have to be capped when the can was not being used.

(5) A highside float can be replaced with an automatic expansion valve, or a thermostatic valve, if the evaporator is of the continuous tube type. It will not be successful on flooded-type evaporators. The Kelvinator you speak of is of the header flooded-type evaporator, and an automatic expansion valve could not be used at all, while a thermostatic valve would undoubtedly develop trouble, due to oil binding or improper refrigeration.

(6) Evaporators placed in the center of the box probably have a slight advantage over those placed at the side, due to a slightly greater circulation of air within the box. This advantage, however, I believe is so slight as to be of little value. The main reason for placing evaporators in the center is to improve, or increase, the storage facilities.

PRODUCTS OF SO_2 AND WATER

QUESTION 288. I read the article on "Driers" in the March issue, and one or two things still are not clear in my mind. The statement was made that activated alumina will dry sulphur dioxide satisfactorily. I was under the impression that the H_2SO_3 or H_2SO_4 which is formed almost immediately when moisture gets in the system, would begin at once to deposit on the compressor parts, etc. Consequently, most of the H_2SO_3 or H_2SO_4 would never pass through the drier because it has already begun to react on the metal parts.

I would like your answer to this situation. Also, what are the chemical symbols of the products produced by the reaction of H_2SO_3 or H_2SO_4 on the parts of the system, and what parts are subject to the reaction?

ANSWER: Since your question referred to the article on "Refrigerant Driers," which was written by Dr. Walker of the Ansul Chemical Co., we are quoting his opinion as follows:

"According to beliefs rather widely held, sulphurous acid (H_2SO_3 and not H_2SO_4) is formed when water and sulphur dioxide are brought in contact with one another. Recent chemical research has thrown considerable doubt upon the existence of an appreciable amount of sulphurous acid being present in a mixture of sulphur dioxide and water. While speculations regarding the existence of sulphurous acid are interesting from the theoretical viewpoint, they have no practical bearing upon the problem of corrosion due to the presence of a small amount of water in liquid sulphur dioxide.

"Sulphur dioxide, containing small amounts of water such as might conceivably be present in a refrigerator, does not immediately react with the metals such as iron, copper, and the alloy brass as shown by the following table.* Data for this table were taken from records of the experimental work from which the corrosion test conclusions were obtained. In all of the cases listed, the percentage of water is higher than that customarily found in a sulphur dioxide machine which might be classified as wet. It is apparent from this table that only in the worst cases does corrosion occur. Moreover, all of our experimental work seems to indicate that even though water is removed during this process of corrosion, its concentration probably is not reduced below .1 percent. This leaves a considerable amount to be removed by the drier and completely justifies

the use of alumina, or any other good drier, for the removal of the residual water.

"The chemical reactions involved in the corrosion of metals by wet sulphur dioxide refrigerant are numerous and complicated, as are the chemical compounds formed. All of these compounds belong to the classes of sulphites and hydrosulphites, examples of which are given below:

H_2SO_3	Sulphurous acid
H_2SO_4	Sulphuric acid
$FeSO_3$	Ferrous (iron) sulphite
$CuSO_3$	Copper sulphite
ZnS_2O_4	Zinc hydrosulphite

*SO_2

.09 percent and below—slight discoloration after two days or more with no further action in 9 months.

.12—discoloration noted after one day to one month. Scale in three weeks or more.

.16—discoloration after a few hours. Corrosion after three weeks or more.

.21—discoloration after few hours. Scale in two or three weeks.

.25—discoloration in short time and slight scale in few hours.

.3—scale after a few hours.

.3 percent is upwards of 60 drops of water in average household machine."

OIL LEAKS AT SEAL

QUESTION 289. **I have had several experiences in having a seal leaking oil and not gas. I have removed the seals, refaced them, and reinstalled same, which would give temporary relief only. Would you please advise me what characteristic takes place to cause this condition to exist?**

ANSWER: It is generally considered that a seal which leaks oil is in the advanced stages of a real leaky seal, or in other words, a seal that leaks oil will, within a short time, also leak gas.

I have heard the theory advanced that the film of oil placed on the seal at the time of assembly will remain at the same thickness originally placed there, and when this film is too great, will cause a seepage of oil through it. This theory, to me, does not sound logical, and, therefore, I do not place much stock in it. However, it may be a point for your own experiment.

I believe your trouble in this case is more likely to be due to some fault in your lapping process, or possibly to materials used, such as for instance, a lapping compound that is too coarse, or a lapping compound which loads up the bronze ring, and continues to cut while the compressor is running; or, perhaps due to a coarse cutting compound you are getting minute scratches across the surface of the seal, which permits the seepage of oil. Perhaps, too, you are not properly burnishing the surfaces for lapping in order to secure a mirror finish as a final process. I would suggest an inspection of your surfaces through an ordinary magnifying reading glass, which I believe might tell you a lot of things about your final job.

Lapping seals, while one of the most common operations in refrigeration service, is, I believe, about the most delicate, requiring the greatest care of any of the repair operations. We have not had a great deal of information on this subject in our columns in the past, but have made arrangements for an article, which we hope will appear within the next two or three issues.

CALCULATING WATER COOLED CONDENSER SIZE

QUESTION 290. **Could you send me a formula for calculating water-cooled condensers (double tube) the B.t.u.'s per sq. ft. per degree temperature difference, at what velocity and pressure?**

The refrigerant tube size and water tube size? I wish to do 500 lbs. i.m.e. per 16 hours.

Also, evaporator size using the thermostatic valve? Liquid and suction line size and receiver formula?

Can you recommend any good books that would give me these formulas?

ANSWER: In trying to write down a formula for the heat transfer from the refrigerant to water in counterflow condensers, I am giving you a formula which I think will be slightly on the safe side where the refrigerant vapor is passed into the outside tube and the internal diameter of the outside tube is approximately $\frac{3}{16}$ inch more than the external diameter of the inside tube. This means that the refrigerant will never be more than $\frac{3}{32}$ inch from the heat transfer of the surface. Under these conditions we can write down a formula

$$L = \frac{\text{B.t.u. per hour}}{31.4 \times D \times \text{M.E.D.}}$$

L = Length of counterflow condenser coil

D = Diameter of the inner tube (water tube)

M.E.D. — The mean effective difference in temperature between the condensing refrigerant and the water in the water coil.

If we consider an average water temperature of approximately 85 degrees which might be 75 degrees in to 95 degrees out, this will give us a 10 degree M.E.D. if we have a 95 degree condensing temperature. If we use a 7/16 inch O.D. water tube and a 5/8 inch O.D. refrigerant tube, applying this formula for the problem you mention which amounts to 500 lbs., i.m.e. for 16 hours or a capacity of 4,500 B.t.u.'s per hour, we find a condenser coil length of approximately 34 feet.

A 1/4 inch liquid line and 1/2 inch suction line should be suitable for methyl chloride. If Freon is to be used, it may be advisable to use a 5/8 inch suction line.

All-Industry Refrigeration and Air Conditioning Exposition

Exhibition Sponsored by Supplies and Parts Manufacturers to Be Held in Chicago January 16-19.

OVER 100 exhibits of manufacturers of refrigerating equipment, accessories and supplies will be on display at the Stevens Hotel, January 16-19. The "All-Industry" Exposition is sponsored by the Refrigeration Supplies and Parts Manufacturers' Association. The exhibits are planned to be interesting in their character, and to introduce the new accessories and equipment which will be featured for 1939.

In conjunction with the Exposition, the Annual Convention of the Refrigeration Supplies and Parts Manufacturers' Association will be held, as well as that of the National Refrigeration Supply Jobbers' Association. Many group meetings of other related associations will convene during this convention. One day has been set aside for the holding of these group meetings, including a meeting for refrigeration service and installation men, which will be under the sponsorship of the Illinois Association of the Refrigeration Service Engineers Society.

The manufacturers will have an Annual Banquet, at which the speakers will include Henry W. Burritt, vice-president in charge of sales, Nash-Kelvinator Corp., and L. R. Boulware, general manager, Carrier Corp.

Officers of the Manufacturers' Association are:

President—J. D. Colyer, Wolverine Tube Co., Detroit, Mich.

Vice-President—J. S. Forbes, Superior Valve & Fittings Co., Pittsburgh, Pa.

Treasurer—H. V. Higley, Ansul Chemical Co., Marinette, Wis.

Officers of the Jobbers' Association are:

President—H. W. Merkel, Merkel Bros. Co., Cincinnati, Ohio.

Vice-President—L. H. Gorton, Machine Tool & Supply Co., Tulsa, Okla.

Directors:

F. A. M. Dawson, Refrigeration Supplies Co., London, Ont., Canada.

D. L. Lingo, D. C. Lingo Co., Houston, Tex.

C. F. Pratt, California Refrigerator Co., San Francisco, Calif.

H. S. McCloud, Williams & Co., Pittsburgh, Pa.

Arnold Dessau, Melchior, Armstrong, Dessau Co., New York, N. Y.

Irving Alter, Harry Alter Co., Chicago, Ill.

F. H. Langsenkamp, Jr., F. H. Langsenkamp Co., Indianapolis, Ind.

FOX RIVER VALLEY CHAPTER RECEIVES CHARTER

PRECEDED by an excellent dinner on the evening of December 5th, Fox River Valley Chapter of Oshkosh, Wisconsin, held a most interesting meeting, which included entertainment and a dance after the business of the evening had been disposed of.

Views of the Tri-County Chapter Thanksgiving Dance and Turkey Raffle held November 19 in Elgin, Ill. Two turkeys, two chickens and two hams were offered as prizes in the raffle. Many visitors from Chicago and other near-by chapters were present for the doings and all reported having had an enjoyable evening. Certainly the expressions of those pictured above indicate it. The pictures were taken by Mr. T. C. McKee, Jr., of Detroit Lubricator Co.

Mr. Dave Barry of Beaver Dam, Wisconsin, acted as master of ceremonies and enlivened the evening with many humorous stories and the introduction of the various events.

Mr. C. Buschkopf, member of the National Board of Directors, briefly responded to an introduction and expressed his pleasure at seeing the Fox River Valley Chapter duly chartered.

Visitors from Madison Chapter and the Illinois State Association were introduced, which included Mead Robertson, president of Madison Chapter; Eugene White of Elgin, Ill., secretary of the Illinois State Assn., and Willis Stafford of Aurora, Ill., a member of the National Board of Directors. Mr. G. D. Wang, president of the Wisconsin State Assn., was also introduced.

Mr. Herman Goldberg of Chicago added to the interest of the meeting by showing several reels of movies, some of which were taken at the national convention in Buffalo, as well as other points.

The charter was presented by H. T. McDermott, national secretary, and Mr. Dave Barry, in a very impressive manner, presented gavels to President Ray R. Moss of Fox River Valley Chapter, and Mead Robertson, president of Madison Chapter.

The officers of the new Fox River Valley Chapter include: Ray R. Moss, *president;* E. K. Wagner, *secretary;* M. B. Guenther, *treasurer.*

SURPRISE FOR MR. THOMPSON

WHILE S. R. Thompson, of Refrigeration Maintenance Corporation, was in Buffalo giving an address before the Refrigeration Service Engineers Society at the convention, he was surprised to learn that he had become the father of twins, a boy and a girl. Mr. Thompson did not have the slightest knowledge that the forthcoming event was to be in duplicate and was totally unprepared for such a shock. They reported that he almost fell over in a dead faint when he learned of the duplicate surprise. The boy and girl have been named "Jack" and "Jill." Congratulations are in order.

NEW ARRIVAL

THE W-M Refrigeration Co., of Milwaukee, Wis., has recently acquired a new attorney, whom it is felt will be on a full-time basis from now on. Anyone in need of legal advice on business or matrimonial matters is invited to consult the very young Frank William McLaughlin, who checked in at the McLaughlin home a few weeks ago.

In other words, Mr. F. E. McLaughlin is the proud father of an 8-¾ lb. boy.

UTILITIES ENGINEERING INTRODUCES "THE CONVENTION NEWS"

AN innovation at the recent R.S.E.S. Convention, in Buffalo, N. Y., was the introduction of "The Convention News" by the Utilities Engineering Institute, of Chicago, Ill.

The paper, which was the first of its kind, was compiled, edited, published and distributed in the hotel at Buffalo, while the convention was in progress. It contained a complete story of events up to the time it went to press, and many interesting personal mentions of those attending.

C. R. Markham, publicity director for the Institute, and E. P. Sorensen, president, were the news-hawks and editors of the paper, while a local printer handled the mechanical work. The idea was a novel one and much enjoyed by those attending.

S S S

PITTSBURGH CHAPTER DISPLAY AT BUFFALO CONVENTION

ONE of the attractions at the 5th Annual Convention in Buffalo in November was the display designed and built by the members of the Pittsburgh Chapter.

The display consisted of a board, approximately six by nine feet in size, with a refrigerated border and panels and the name in frosted letters. Posted in the panels of the board were pictures of various chapter doings, refrigeration installations made by the members of the chapter, and statistical information concerning the chapter and local jobbers.

The statistical information quoted, among other things, the total purchasing power of the chapter, the area in square miles served by its members, a list of jobbers located in the city, and the territory served by them.

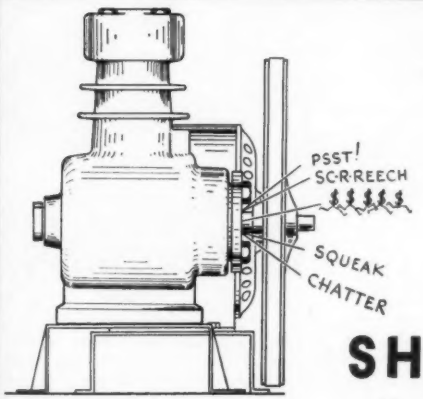
The entire display was well planned and attractively made.

S S S

THE GLASS HONEYMOON

WE often hear of the man who combines business with pleasure, but Mr. J. Glass, of H. Channon Co., Chicago, Ill., recently changed the order when he combined business with a honeymoon.

Mr. Glass was married on October 29, and taking advantage of the close proximity of



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the R.S.E.S. Convention to Niagara Falls, he and his bride spent their honeymoon attending the convention and visiting the Falls. Congratulations, Mr. Glass!

Chapter Notes

Under this heading will appear news of the chapter meetings. For names of the officers and dates of regular meeting nights, please refer to the Chapter Directory.

MADISON CHAPTER

October 26—After the usual business session, Mr. Quam, chairman of the Educational Committee, with the aid of Mr. Carlson, started a new educational program which is a study of the national Lecture Course. The first two lectures were covered during the evening and it was found to be a very interesting discussion.

Mr. Liebley introduced Messrs. Delavan, Marshal and Clark of the Automatic Products Corp., who gave an interesting educational program on their products for the balance of the evening.

November 8—Continuing with the educational program which specializes in the study of the national Lecture Course, Mr. Quam gave a very concise outline of Lecture 4.

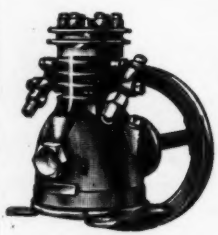
Mr. A. Janeck was appointed Chairman of the Publicity Committee, with special instructions to see that announcements of the events were published in local newspapers.

Mr. George Poster was appointed custodian of the working materials of the chapter and charged with the responsibility of seeing that these were kept in proper condition and available for each meeting. Space in the hotel is to be rented for the storage of this property.

A round-table discussion followed on methods of conducting future educational meetings. Much information was derived from this discussion, and definite plans may be formulated in the future.

November 22—President M. Robertson gave the highlights of the Buffalo convention as derived from Mr. McDermott's report in THE REFRIGERATION SERVICE ENGINEER.

Messrs. Struthers and Carlson gave a very thorough demonstration of Carrene at 45 degrees below zero with a 28 inch vacuum; also a demonstration of freezing water with a 28 inch vacuum and no refrigerant. This demonstration proved extremely interesting



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are designed to give you many years of quiet, efficient and trouble free service by Engineers who have been serving the refrigeration industry for the last fourteen years.

They have again "scored a hit" with a new "V" type four cylinder compressor which is designed for use with ½ to 1 HP motors. All of the advanced features that have proven so successful in "Chieftain" household and light commercial units are now incorporated in this new four cylinder model.

Mechanical improvements include, force feed lubrication to piston pin and connecting rod bearings, positive alignment of cylinder bores with main bearings by casting cylinders and crankcase in one piece. Adjustable suction shut-off valve, interchangeable parts with single and twin cylinder models. All compressor parts are machined to precision limits on up to date equipment and assembled in glass enclosed rooms where only filtered, dust free air is admitted.

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and enlightening to the members.

Mr. Max Kleifuth of the Research Laboratories then took charge of the meeting with an exceptionally good talk on filters. Samples of the filters manufactured by his company were displayed and he pointed out the different types required under different cleansing conditions.

The membership of the chapter feel they owe Mr. Larson a vote of thanks for the selection of speakers he has brought to them. Each speaker has left a good impression and much knowledge which would be hard to obtain through any other source.

PITTSBURGH CHAPTER

November 11—A detailed report of the Buffalo convention was given by Delegate N. D. Wagener. Pictures of the display by Pittsburgh Chapter at the convention and a complete report of its success was given by Mr. E. V. Black. The cost of the display was taken from the chapter treasury.

A discussion followed on the desirability of having the examination for Certificate Membership, which resulted in a tentative date in January being set for the examination.

November 17—This was a special meeting conducted in the plant of Williams and Co. at 901 Pennsylvania Avenue, Pittsburgh. Mr. E. V. Black presided and immediately turned the meeting over to Mr. J. C. Hipps, who took the assemblage on a tour through the plant, showing the coil manufacturing machinery and giving a complete demonstration on the manufacturing and testing methods. Mr. H. S. McCloud gave most of the explanations of the methods used and the seventy members present found the entire tour very interesting.

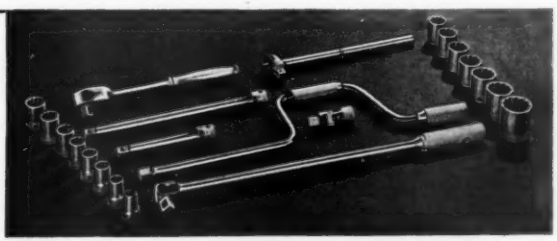
Mr. K. M. Newcum was introduced by Mr. McCloud and gave an interesting talk on Superior valves and fittings.

Many non-members were present in the gathering and Mr. Black explained the objects of the Society for their benefit and the aims of the Pittsburgh Chapter in particular, and extended an invitation for the non-members to attend the next chapter meeting.

WICHITA CHAPTER

November 4—During the regular course of business, Mr. F. W. Ryan told of the

BE READY FOR EVERY JOB . . .



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opportunity to visit one of the local locker plants at any time convenient to the chapter. He also read an article on the origin of the Kelvinator Corporation as described in an article he had obtained.

A discussion on the Electrolux refrigerator and its operation, and also on oil separators, was led by Mr. Ryan. All of the discussions proved very interesting.

November 11—The educational program of the evening consisted of the showing of the Frigidaire film portraying the operation and construction of thermostatic expansion valves; also, a film entitled "Sand on Slippery Sidewalks."

The showing of these films was followed by a general discussion on expansion valves and controls.

The entire meeting was of unusual success and was very well attended. Mr. Ryan is to be congratulated on the excellent program he was able to attain.

November 18—After a short business session, the meeting was turned over to Mr. G. B. Govits of the Educational Committee, who introduced Mr. J. A. Wilkerson. Mr. Wilkerson gave an interesting talk on Henry Valve products and the Dole cold plates.

The information derived from this talk was very helpful to those actively engaged in the servicing of refrigerators.

DAYTON CHAPTER

October 28—Since this was the last meeting before the Buffalo convention, Mr. H. R. Shoupp was appointed as the chapter delegate and instructions were given him expressing the chapter's desires in business which was to be conducted at the convention.

The business of the evening was cut short and the major part of the time devoted to nomination of officers for the ensuing year and election will take place at the next meeting on November 11.

November 11—The major part of the evening was devoted to the election of officers, with the following results: R. J. Brown, *president;* J. F. Becker, *1st vice-president;* George Click, *2nd vice-president;* G. O. Snyder, *secretary;* E. O. Bowman, *treasurer;* C. L. Price, *sergeant-at-arms.*

BOSTON CHAPTER

November 14—An interesting and well attended meeting of the chapter was held on this date, and opened with a very con-

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cise report given by President J. B. Coffey on the Buffalo convention. Further reports were also heard from Mr. R. R. Seddon, who was the alternate delegate from the chapter, and from Mr. Chester Borden of the A. E. Borden Company of Boston, who had also attended.

Some discussion followed as to the possibilities of having a future convention held in Boston but no definite decision was reached.

SPRINGFIELD CHAPTER

October 26—During the course of business, a Membership Committee was appointed and it was decided that any future applications for membership would be turned over to the committee for investigation before acceptance and the committee would make a report to the chapter on their findings.

Some discussion followed on the constitution and by-laws of the Society and the Secretary was instructed to bring to the next meeting a copy of the constitution and by-laws which were compiled during the formative period of the chapter.

November 9—During the early part of the meeting, Mr. J. J. Kline was introduced by Mr. P. W. McVay as the tube bending champion of the world. Mr. Kline, it will be remembered, won the tube bending contest at the Buffalo convention. Springfield Chapter is very proud of the representative they entered in this contest.

The constitution and by-laws of the local chapter which were adopted at one of the formative meetings were read by President McVay. After some discussion it was decided that the following should be incorporated: "That the Secretary send notices to each member at least four days before each regular meeting and each special meeting to his last known address."

The change was incorporated in Article 8, Section 3 of the by-laws.

A general discussion of events at the national convention was given by those members who attended.

KANSAS CITY CHAPTER

November 8—During the reports of committees, Mr. J. DeWilde, chairman of the Educational Committee, stated that a discussion of the Lecture Course would start immediately after the first of the year. This course would be offered to prospective mem-

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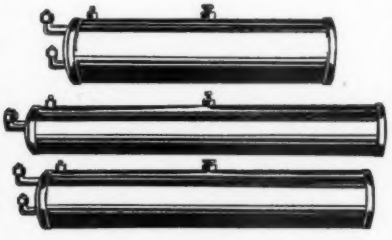

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bers as an added incentive in obtaining their membership.

Chairman of the Membership Committee, Mr. H. F. Andrews, reported that the membership drive was showing very good results, with very keen competition between the captains—Mr. E. Bloesser and C. L. Hataway.

Mr. S. A. Leitner gave a complete report of the Fifth Annual Convention at Buffalo, covering in detail all of the activities from start to finish.

Under good and welfare of the chapter, Mr. C. B. Scofield suggested that a representative from the Socony Oil Company be asked to speak on refrigeration oils. This matter was referred to the Educational Committee for future consideration.

The educational program of the evening consisted primarily of a discussion of questions received in the Question Box. This feature proved interesting to all concerned.

TRI-STATE CHAPTER

November 7—The greater part of the evening was devoted to discussions of the Buffalo convention by members who had attended.

Mr. Poole reported on the business sessions and educational papers which were presented and the fine displays of the manufacturers and jobbers, and on the fine entertainment provided by the Niagara Frontier Chapter.

Mr. M. E. Harrison, who acted as Chairman of the Nominating Committee at the convention, spoke briefly of the fine men who were nominated and elected as the national officers for the coming year.

Mr. Albertsen gave his impression of the many features provided.

Mr. Poole then gave a short synopsis of the motion picture "Imprisoned Freshness" and President Brunton expressed his views of the convention in general and his pleasure at being elected National President.

Mr. Harrison gave a report of the Ladies Auxiliary and asked the support of the members in giving the ladies any help they may need.

Mr. Albertsen described the tube bending contest held at the convention and stated that this feature would be available to the chapter in the near future.

MISSOURI VALLEY CHAPTER

October 20—After the usual opening preliminaries of the meeting, President Doyle broached the subject of the refrigeration

and air conditioning code in Omaha.

Mr. George Sebree gave a short discussion of the principal points of the proposed Detroit code. Considerable discussion followed and the members were asked to thoroughly study the proposed Detroit code so they would be better prepared to recommend one for adoption in the city of Omaha.

The membership expressed a desire that a speaker furnished by a manufacturer of refrigeration and air conditioning supplies be secured for future meetings and that a definite program of same be laid out. The matter was turned over to the Educational Committee.

MISSISSIPPI VALLEY CHAPTER

October 28—During the course of the meeting the Secretary was instructed to write to the Alco Valve Company and ask for their Mr. J. A. Schenk to appear on the program as a guest speaker at the February 10th, 1939, meeting and ask that he bring with him their glass evaporator.

A discussion of an annual banquet resulted in the appointment of a committee consisting of Messrs. Oscar Carlson, A. B. Munchrath, Fred Tindall and E. L. Bengston. These men were asked to formulate some plans for the banquet and report at the next meeting.

A tube bending contest was the main feature of the evening and Messrs. E. J. Ford, Oscar Carlson and E. J. Soens were appointed as judges. The contest proved very interesting and entertaining and the prizes were as follows: Lonnie Fish, first prize, $3.00; Bill Cawiezell, second prize, $2.00; Leonard Nelson, third prize, $1.00.

CAPITAL CITY CHAPTER

October 26—Mr. E. J. Uhthoff appointed an Educational Committee consisting of Messrs. N. Burdette and M. H. Hamilton with a special request that they try to make up an educational program including interesting features for every meeting night. It was suggested by Mr. Sweeney that the older refrigeration units be obtained for the purpose of dismantling and studying their operation and construction in the meetings. This suggestion was considered worthwhile and the newly appointed Educational Committee is to make arrangements.

November 16—Mr. Eaves of Detroit was introduced by Mr. Price and gave a short talk on the manner of conducting meetings of other societies.

AT LAST..

•

THE WHOLE TRUTH ABOUT SULFUR DIOXIDE

Every service engineer in the refrigeration field should read "Sulfur Dioxide as a Refrigerant," an authoritative paper by Augustus H. Eustis, member of the American Society of Refrigerating Engineers and President of the Virginia Smelting Company. Sulfur Dioxide is described from every angle both theoretical and practical, and popular fallacies are fearlessly discussed. Containing practical tables and service data, this paper constitutes a reference text of great value to those who realize the necessity of being thoroughly posted on the characteristics and problems of this leading refrigerant gas. We will be glad to send you a free copy.

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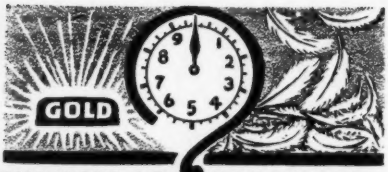

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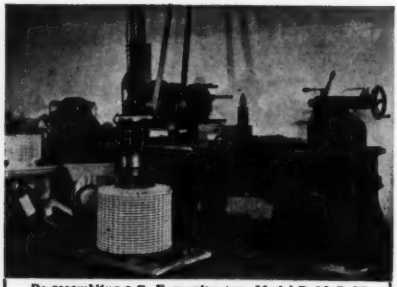

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HERMETIC ENGINEERS

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As part of the educational program of the evening, Mr. Uhthoff and Mr. Price read and discussed a paper on the subject of dryers and drying agents.

Mr. Sweeney of Melchior, Armstrong, Dessau Co. was then introduced and gave a demonstration of how the drying agent Activated Alumina could be tested for moisture content.

Mr. E. H. Ferrill of the Kerotest Manufacturing Co. was then introduced and gave a short talk on the old Kelvinator brine systems and his experiences in his days of service work.

Mr. Uhthoff gave a very complete report on the convention covering all its details.

TRI-COUNTY CHAPTER

October 21—The major part of the evening was devoted to a discussion of future entertainment to be given by the chapter. A motion was made and carried that the chapter hold a Thanksgiving dance and turkey raffle in Elgin on November 19th. Further discussions followed and some definite plans were made.

CHICAGO CHAPTER

November 15—The greater part of the meeting was devoted to reports of Delegate Ivar Skipple on the events of the national convention at Buffalo. This was supplemented by descriptions given by other members who attended.

Following these reports, Johns-Manville presented their sound film, entitled "Heat and Its Control."

A short business session followed the showing of this film in which were discussions of future programs of the chapter.

November 29—This meeting was designated as Commercial Coil and Refrigeration Co. night in which they gave a demonstration of the Coltrol DX beer cooling system. Mr. Wm. Gauger gave a very complete description of the construction and operation of this unit and wound up the demonstration by cooling beer and serving it to the members in attendance.

Announcement was made of the forthcoming meeting to be held on December 18th at which time a social evening for both ladies and members will be held. The features of this evening's entertainment are a talk on "Safety" by Mr. V. C. Kelsey of the Accident Prevention Department of the Commercial Standard Insurance Co., the

showing of movies taken by Herman Goldberg at the Buffalo convention, a tube bending contest sponsored by the Imperial Brass Mfg. Co., and finally, entertainment and dancing for the balance of the evening. No charge will be made for this evening's entertainment and everyone is invited to attend.

ATLANTA CHAPTER

October 20—The major part of the evening was devoted to the presentation of the chapter charter by National President, W. H. Moss. The meeting started with an enjoyable dinner, after which Mr. Moss gave a very instructive talk on the purposes and aims of the organization.

During the business session and latter part of the evening, the delegate to the national convention was appointed and instructed in accordance with the desires of the chapter.

November 24—Immediately after calling the meeting to order, President T. L. Carnell gave a complete report of happenings at the Buffalo convention.

Following this, nominations were received, and election of officers for the ensuing year took place, with the following results: T. L. Carnell, *president;* S. Mayfield, *1st vice-president;* J. F. Gresham, *2nd vice-president;* D. Alexander, *treasurer;* H. W. Gullatt, *secretary;* J. Stephens, *sergeant-at-arms; Board of Directors:* C. Biggers, T. H. Hart, W. M. Rapp, Jr., Bob Graves and George Weldon.

After some discussion, it was decided that the chapter would adopt the same fiscal year as the National Association, which is from July 1st to June 30th of each year.

The newly elected officers will serve until June 30, 1939.

Regular meeting nights in the future are designated as the 5th and 20th of each month.

S S S

INDIANAPOLIS LADIES AUXILIARY

September 17—The Fall social activities began with a wiener roast, which enjoyed rather unusual success. On October 27th a masked Halloween Ball proved to be a very interesting evening.

November 5—The membership drive of the Auxiliary is still going strong and to aid activities, Mr. and Mrs. R. C. Robinson are reported the proud parents of a new baby girl, a future candidate for membership.

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STRIKES THE BALANCE BETWEEN EFFICIENT OPERATION AND CLOSE TEMPERATURE CONTROL

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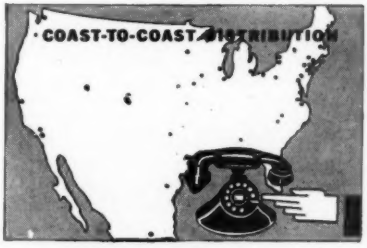

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The TWIST OF A SCREW DRIVER CORRECTS the WHOLE SCALE

When a thermometer or gauge has the patented Marsh "RECALIBRATOR", you simply turn the convenient RECALIBRATOR screw until the pointer is corrected at any point on the dial. The instrument is then correct at all points because the device compensates for the bourdon tube and actually re-calibrates the instrument.
The Marsh line of thermometers, gauges and recorders cover all refrigerants, pressures, and conditions. Ask for the big catalog.
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MARSH Refrigeration Instruments

At the November 8th meeting a very concise report of the Buffalo convention was given with special emphasis on the formation of the national organization of the Ladies Auxiliary. The Indianapolis ladies are very much gratified to learn that one of their members has been appointed on the National Board of Directors.

The rest of this evening's meeting was devoted to a book review of Anne Lindbergh's new book entitled, "Listen, the Wind."

S S S

REX REFRIGERATION HOLDS OPEN HOUSE

THE Rex Refrigeration Service, Inc. for the past number of years have been engaged in the rapidly increasing business of rebuilding hermetically-sealed units. In recent months, they have branched out into the sale of new appliances.

Their specialty in the hermetic work was for several years General Electric units, branching out later to units of other makes.

History is apparently repeating itself in that their first efforts in the sales business are on the complete line of General Electric appliances. They have been granted a dealership by the General Electric Co.

So that salesmen, building managers, etc., may become acquainted with what the company has to offer in the line of sales and service, Rex Refrigeration Service held open house on December 2, 1938. About 250 men attended during the afternoon and evening. A buffet lunch and refreshments were served the visitors.

S S S

ALARM CONTACTS AVAILABLE ON PENN ICE CREAM CABINET CONTROL

AN alarm feature for warning attendants when refrigeration equipment fails to maintain desired low temperature has been added to the "260 Series" semi-commercial refrigeration controls built by Penn Electric Switch Co., Goshen, Indiana. The over-run alarm will be offered as an optional construction on all "260 Series" temperature models and is designed primarily for ice cream cabinet service.

These controls have auxiliary contacts which close five to ten degrees (as specified)

HERMETIC REBUILDING SERVICE
G.E.—Westinghouse and Majestic
Customers in 37 states had hermetically sealed units rebuilt or exchanged by us in the past year. Complete factory equipment for precision rebuilding. One year guarantee on all rebuilt units. Exchange service available on most makes and models. Write for prices and descriptive literature.
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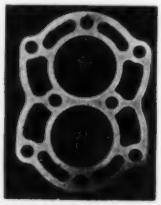
for all makes of compressors.
Send for new bulletin No. 40



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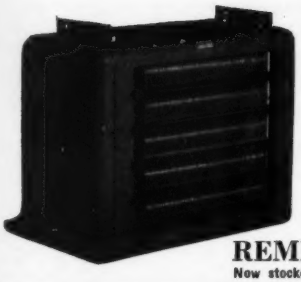
7701 S. AVALON AVE., CHICAGO, ILL.



for air as cold as

There's a Rempe unit cooler for every purpose, every refrigerant, every temperature. 336 varieties of sizes and coils. Temperatures even lower than 11° on special orders. And they offer the kind of efficiency that always spells complete SATISFACTION.

11° *and even colder!*

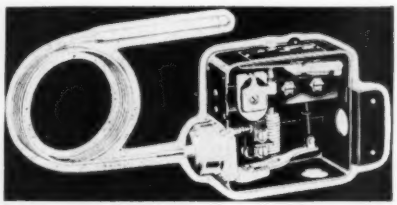
Write for Bulletin 105

REMPE CO., 340 N. Sacramento Blvd., CHICAGO

Now stocked by Leo S. Bosarge Company, 315 Spring St., N.W., Atlanta, Ga.

above the control cut-in point, to sound a bell or light a signal lamp. They are rated for alarm duty only, while the main contacts, which are the Penn permanent magnet type, carry motor loads up to ¾-h.p. a.c. and ½-h.p. d.c.

Since the addition of the alarm feature



The Penn control with alarm contacts.

involves no change in the dimension of these "thin model" switches, their advantages for applications where space is limited are retained. Mounted by feet or angle bracket, the controls may be installed in insulation space or any other desirable location. Bulletin R-9C describes the new construction and other features of the "260 Series."

Vincent Brass and Copper Handles Penn Controls

The Vincent Brass and Copper Company, 100 North Second Street, Minneapolis, Minnesota, has been named special representative for Penn Electric Switch Co. in Minnesota, North and South Dakota, and western Wisconsin.

The Vincent Brass and Copper Company, headed by R. L. and G. F. Vincent, was established in 1936 as factory representatives for heating and refrigeration specialties. The new connection adds to their products a complete line of controls for heating, refrigeration, air conditioning, and pump and air compressor service.

An engineer trained at the Penn home office and factory in Goshen, Indiana, is directing Vincent's control engineering division. Their Minneapolis warehouse will carry a stock of controls and repair parts for prompt shipment to manufacturers and distributors in the territory.

"Our new representatives have succeeded in establishing a wide circle of friends among the manufacturers, distributors, and dealers of the Northwest," R. H. Luscombe, Penn sales manager, said in announcing the new

Take All Wheel Gear Puller

A midget with the pull of an elephant. Every serviceman and shop needs one. High grade steel. Sturdy, compact, light weight (2 lbs.). Meets practically all requirements, where a puller is used. Changeable from three to two arm puller, almost instantly.

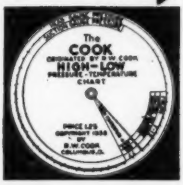
PRICE $4.95 F.O.B.

FLUSHING REFRIGERATION CO., INC.

133-22 41st Ave. **FLUSHING, N. Y.**

You NEED This

This HEAD PRESSURE CALCULATOR gives you HEAD PRESSURES for ANY air cooled installation using SO_2, Methyl, or F-12.



Price $1.25. See your REFRIGERATION JOBBER or send check to

THE COOK CO.
Box 176, Columbus, Ohio

DENNIS GASKETS
FOR ALL MAKES REFRIGERATOR DOORS

A complete line of rubber - coated, packed Gaskets and extruded rubber Gaskets that last longer —retain higher efficiency—because made of finest materials and workmanship. Write for free samples, giving your jobber's name and address.

W. J. DENNIS & CO.
2110-20 WEST LAKE ST. — CHICAGO

arrangement. "We are confident that our customers in that area will find their facilities for control engineering and service excellent."

NEW-TYPE DIAPHRAGM VALVE

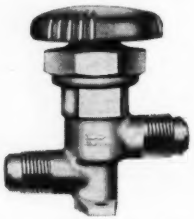
MUELLER BRASS CO., Port Huron, Mich., announces the new Tripl-Seal Line Valve, which is constructed upon a new and revolutionary principle. The valve is operated by means of four levers. When the handle is turned, the diaphragms move downward slightly, contacting the lever plate which in turn causes the levers to multiply the travel of the stem in an approximate ratio of three to one in opening or closing the valve.

Because of the small amount of movement, the multiple diaphragm which has approximately 20 percent increased surface area over other types of diaphragms, is never deflected past its normal center, thus immeasurably prolonging its life.

In conventional diaphragm operation, the diaphragm operates through and beyond its center point. Continued operation fatigues the metal at its edges where it is secured in the valve.

Positive sealing at three essential points in the valve is adequately provided for.

The stem of the new Tripl-Seal Valve is provided with a 60-degree bevel, thus procuring the most desirable wedging action for positive and easy closing. It is manufactured from Tuf-Stuf, a strong, corrosion-resistant alloy. The stem does not rotate, and is constantly guided into the same position against the seat by a cylindrical guide, so processed as to eliminate any possibility of distortion.



MUELLER BROS. CO. TRIPL-SEAL VALVE.

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EXPANSION VALVES

Send your order to

REFRIGERATION SUPPLIES CO., LTD
LONDON • ONTARIO

Jarrow Replacement Door Gaskets

The gasket illustrated was made especially for GRUNOW replacement. It fits. ALL JARROW gaskets are built to Manufacturers' specifications. Insist on JARROW GASKETS. Your nearest Jobber has them.

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QUICK SERVICE
PARTS · SUPPLIES · TOOLS
for Refrigeration-Air Conditioning
DEPENDABLE ITEMS FOR ALL YOUR NEEDS
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Airo SUPPLY COMPANY
Phone Graceland 6550
2732 N. Ashland Ave.
CHICAGO
WRITE TODAY for NEW CATALOG

Valves are furnished in two-way, three-way, and angle-type—flared or solder-type ends—and in complete range of all necessary sizes.

Order through your jobber—he stocks the complete line.

S S S

BRASS & COPPER SALES CO. PURCHASE SPANGLER CO. OF ST. LOUIS, MO.

ON November 22nd, the United States District Court No. 2 at St. Louis, Missouri authorized Robert T. Hensley, the Trustee for the Spangler Co. to sell the inventory, accounts receivables, furniture, fixtures and equipment of the Spangler Co. to the Brass and Copper Sales Co., 2817 Laclede Avenue, St. Louis, Missouri. All of these assets have now been transferred and the Brass and Copper Sales Co. are now carrying in addition to the complete line of refrigeration and air conditioning supplies and accessories that they had, the complete stock formerly carried by the Spangler Co. Several Spangler employees have been retained by the Brass and Copper Sales Co. in their effort to render an increasingly better service to Peoria and south in southern Illinois, western Kentucky and the state of Missouri, with parts of the state of Arkansas.

S S S

HEAD PRESSURES SOLVED

HEAD pressures have been one of the serviceman's greatest difficulties in analyzing refrigeration troubles. Heretofore, he has had no convenient means of definitely determining what the head pressure for each individual installation should be.

Now, he has been given a proven tool with which to check head pressures. This new tool—the Cook High-Low Pressure-Temperature Chart—has been made possible through the cooperation of some of the largest manufacturers of refrigeration equipment and several years of research. From the infor-

WE REALLY CAN SAVE YOU MONEY

on all your refrigeration parts, tools and supplies. We ship orders same day as received whenever possible. Write on your letterhead for our complete new catalog.
Our stock is always complete.
H. W. BLYTHE CO.
2334 So. Michigan, Chicago

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POSITIVE CONTROL LIQUID COOLERS
COMMERCIAL COIL and REFRIGERATION CO.
459 N. Artesian Ave., Chicago

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We have a complete stock of all replacement parts for electric motors!
Write for catalog

CAPACITOR TEST BOX
This device is the only means of determining whether or not a Capacitor is defective. Turning the mfd. selector determines what size is necessary for replacement. The test box may be left in the circuit while a replacement is secured.

COMPLETE ELECTRIC SUPPLY CO.
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COLD CONTROLS & EXPANSION VALVES
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at the following prices, F.O.B. Chicago

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Commercial Controls (Temp. or Pressure)	2.50
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ALL WORK GUARANTEED FOR 90 DAYS
Write for quantity prices

NEW DUTY
2424 Irving Park Blvd., CHICAGO

mation given on this Chart, he can instantly tell if the system has too much liquid, air, or a dirty condenser. It gives the service engineer the proper head pressure for any air-cooled installation using Freon (F-12) methyl chloride or sulphur dioxide, when installed and operating properly. This Calculator is pocket size, only 3 inches in diameter. For further information write The Cook Co., P. O. Box 176, Columbus, Ohio.

NEW CATALOGS AND BULLETINS

Complete Electric Supply Co., 526 W. Van Buren St., Chicago, Ill., has just issued a 104-page catalog, illustrating one of the most complete stocks of motor repair parts in the country.

In the preface of their catalog, the Complete Electric Supply Co. states, "We welcome all orders, large or small, and give them all our immediate attention. Our policy is 'same day service' when possible."

So that these catalogs will not reach other than legitimate hands, no requests for them will be filled unless made on your company letterhead. Write for your copy now.

CALIFORNIA REFRIGERATOR CO. BUYS GRUNOW PARTS AGENCY

THE George H. Eberhard Co., former Pacific Coast distributors for Grunow refrigerators, who have now taken on the Sparton distributorship, have sold their stock of Grunow compressors, parts, accessories, etc., to the California Refrigerator Co. at 1077 Mission St., according to announcement made by President Clarence F. (Sandy) Pratt here today. The Eberhard Co. have been distributors for many years for the Grunow refrigerators and expect to make an active campaign on Spartons. The California Refrigerator Co. has also been appointed authorized jobbers for genuine Grunow parts for Northern California and vicinity. There are about 13,000 Grunows in this territory.

I. T. & T. ENTERS THE REFRIGERATION EXPORT BUSINESS

THROUGH two additional contracts signed by the International Standard Electric Corporation, world-wide manufacturing and sales subsidiary of the International Telephone and Telegraph Corporation with Midwestern manufacturers, the I. T. & T. is now equipped to supply abroad a complete line of electric refrigeration and air conditioning products. It announced a contract with the Gibson Refrigerator Company of Greenville, Michigan, several weeks ago. The new contracts are with the Mills Novelty Company of Chicago and the Baker Ice Machine Company of Omaha. Gibson provides a high grade household refrigerator,

MERRY XMAS

A Very Merry Xmas to our many customers. May we continue our valued relationship. Watch for our newest catalog No. 39, soon to be released, showing the very latest air conditioning, refrigeration and heating supplies.

Send for your copy now.

H. CHANNON CO.

133 N. Wacker Drive, CHICAGO, ILLINOIS—Franklin 0380

Proof of Trouble-Free Service—No ALCO "TK" Thermo Valve Has Ever Lost Its Charge!

SINCE its introduction not a single "TK" valve has been returned because of power assembly failure. Alco "TK" Thermo Valves offer you all the proven advantages of the famous Alco "T" series valves at a saving of 20 to 40% in cost.

Ideal for small refrigeration and air conditioning systems, Alco "TK" Thermo Valves deliver accurate, trouble-free service throughout their long life. Details include atomic hydrogen welded power assembly, large, adequate filter area, light weight and simple design, yet as sturdy as larger valves.

See your jobber for complete information and specifications.

ALCO VALVE COMPANY, INC.
2630 Big Bend Blvd.
St. Louis, Mo.

ALCO

Engineered Refrigerant Controls for Highest Evaporator Efficiency

Mills the smaller size industrial icing and refrigerating units and Baker the large icing machines and air conditioning equipment.

The contracts provide for manufacturing rights and technical assistance, and the I. T. & T. plans eventually to manufacture these equipments in several of its European factories. For the present, however, they will be exported and marketed abroad under the Standard Electric trademark.

Principally manufacturers of all types of telephone, telegraph, cable and radio equipment, the I. T. & T. management is effecting a diversification policy. Several new lines of manufacture have been added for the factories in Belgium, England, France, Germany and Australia with electric refrigeration potentially the most important.

S S S

R. L. HENDRICKSON RETURNS TO U. E. I.

AFTER an extended leave of absence, during which time he was actively engaged in designing, laying out and installing air conditioning and heating systems, R. L. Hendrickson returns to his old post as Chief Engineer of the Utilities Engineering Institute.

Having had many years experience in all phases of air conditioning and refrigeration, Mr. Hendrickson requested a one year leave of absence from his responsibilities at the Institute for the purpose of getting practical experience on engineering problems as they confront the men in the industry.

Among his other accomplishments, Mr. Hendrickson designed and installed refrigerated locker systems, milk cooling plants and different types of beverage cooling equipment. He also designed, estimated and supervised the installation of air conditioning equipment in a wide variety of applications.

MAKE YOUR SPARE MOMENTS PAY

You will enjoy every minute of the time you spend in the study of U.E.I. training. Most important of all, however, are the innumerable benefits you derive. Real pay raising knowledge is the very essence of the U.E.I. course.

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describes the training and tells how others have profited. Write for it today.

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404 N. Wells St., Chicago
17 W. 60th St., New York, N. Y.

Desiring to make a study of the problems confronting dealers and distributors, Mr. Hendrickson became associated with a large distributor of refrigeration equipment in Omaha where he supervised commercial sales activities and established dealer contacts. Mr. Hendrickson is well known throughout the industry and returns to the Institute with a wealth of new, practical ideas, which will be incorporated in the training program of the school. He is a member of the R.S.E.S., A.S.R.E., and the A.S.H.V.E.

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With IMPERIAL FITTINGS the system remains tight!

THE success of any refrigeration or air conditioning system is absolutely dependent upon tight connections.

Imperial fittings in both S.A.E. flared type and solder type have been especially designed for refrigeration work.

Nuts, tees, elbows and crosses are made from brass forgings and will not crack or split. They are heavier and stronger than the standard S.A.E. fittings and are non-porous, eliminating seepage and season cracking. Tees and elbows have flats for wrench hold. On fittings with female threads made from rod, Imperial uses an extruded bronze rod. This extruded bronze is not subject to season cracking. Imperial solder fittings are forged with the exception of couplings and return bends which are made from drawn seamless copper tube.

Imperial Brass Mfg. Co., 1204 W. Harrison St., Chicago

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IMPERIAL Air Conditioning and Refrigeration Products

VALVES • FITTINGS • TOOLS • CHARGING LINES • FLOATS • STRAINERS • DEHYDRATORS

SELL THE PEERLESS WALL TYPE UNIT COOLER

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● Your customers will like the added storage space that this compact unit makes possible. Its steady, gentle stream of cooled, high humidity air permits proper refrigeration without profit-taking drying of products. Equipped with our Thermek or spine coil, the most efficient evaporating surface that has been developed.

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Peerless Products Will Be Shown In Booths 116, 117 and 118, First All-Industry Exposition, Jan. 16-19th, Hotel Stevens, Chicago.

Merry Christmas and a Happy New Year

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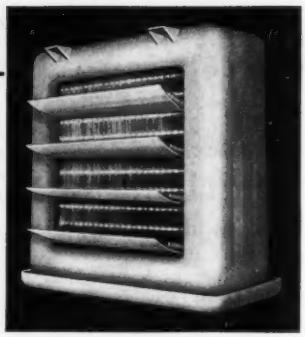
Mills Compressors

★ Mills Novelty Company
4100 Fullerton Avenue, Chicago, Illinois

SOLD ONLY THROUGH SERVICEMEN, DEALERS, AND DISTRIBUTORS



For Product Cooling

MARLO
UNIT COOLERS

Designed especially for Walkin Refrigerators, 34 degrees and over, these Units can also be used for Air Conditioning.

The Coil Cores in Marlo Unit Coolers are Headered, and the Tubing proportioned in Circuits that eliminates any short circuiting of the Refrigerants and insures an even Coil temperature.

Housings are made of Aluminum two-piece Castings. Fan Motor, Fan and Coil Cores are easily removed for inspection if necessary. All Marlo Unit Coolers are conservatively rated.

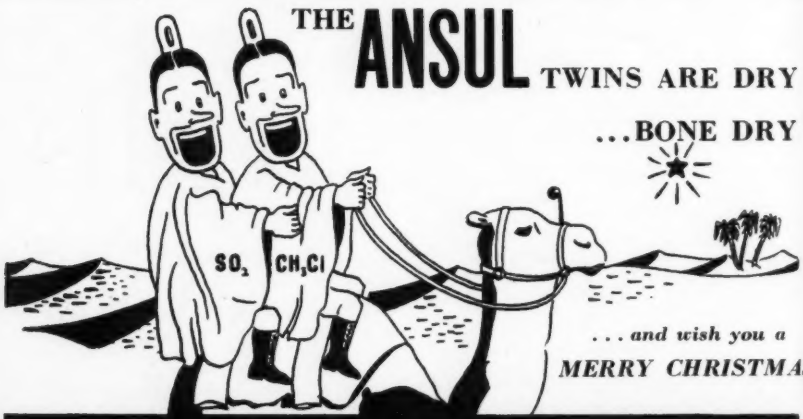
Send for Complete Information and Literature

Marlo Coil Co., 6135 Manchester Ave., St. Louis, Mo.

Manufacturers of Complete Line of Low Side Equipment W-2R2

THE **ANSUL** TWINS ARE DRY

...BONE DRY



. . . and wish you a
MERRY CHRISTMAS

ANSUL TWINS

SULPHUR DIOXIDE

METHYL CHLORIDE

ANSUL CHEMICAL CO., MARINETTE, WISCONSIN

There Is An Ansul Jobber Near You

IS IT TRUE WHAT THEY SAY ABOUT HENRY?

Has the Abso-Dry Pressure-Sealing Process Brought New Efficiency in Dryer Performance?

"Yes!" shouts the industry with an avalanche of orders. Today every man in the field should know that a dryer that does not hiss is as obsolete as a celluloid collar and a fancy vest.

Henry's exclusive process first removes every trace of moisture from a dryer; then it is pressure-sealed with dehydrated air. No matter how long a period may elapse until actual installation, this fact stands out: *The hissing sound you hear when you loosen the seal cap of a Henry Dryer is absolute proof of original factory dryness.* If a Henry Dryer does not hiss, your jobber will exchange it for a new one.

Protect your jobs against expensive service "call backs." Insist upon the new Henry Abso-Dry Dryer. It costs no more than ordinary dryers and guarantees *its* dryness with a hiss-s-s-s!

THE SONG OF THE DRYER

To the tune "Is It True What They Say About Dixie?"

Is it true what they say about Henry,
Is his charge ABSO-DRY all the time?
Is every trace of moisture removed
From Henry's core?
Does Pressure-Sealing fix him
So he will soak up more?

•

Is it true that he'll save you more money,
Every time he's installed in a line?
ABSO-lutely! Remember the last
Line of this song:
Henry's hiss proves you can't Go wrong!

MOST COMPLETE LINE OF DRYERS, STRAINERS AND LINE VALVES FOR REFRIGERATION AND AIR CONDITIONING — ALSO AMMONIA VALVES AND FORGED STEEL FITTINGS

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STOCKED AND SOLD BY LEADING JOBBERS

HENRY VALVE CO.

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A Complete Line for Refrigeration Service

Complete sets of special refrigeration sockets and attachments including ratchet, packed in handy, pocket size metal case.

For more than 60 years The Bonney Policy—"The right tool for every job".

Today Bonney offers the most complete line of REFRIGERATION service tools.

Just a few specialized tools for special applications are shown. The full line is complete.

Included also are a full line of standard double-hexagon sockets with handles and attachments, open-end and box wrenches, screw drivers, punches, chisels, pliers, hammers, tube cutters, etc.

Good tools assure good work in the least possible time. Write for complete catalog of Bonney Tools —"The Finest That Money Can Buy" for Refrigeration Service Work.

Special socket wrench for inserting and removing Fedders cartridge type needle seat assembly. Has ⅝" hexagon opening.

Tee handle packing gland nut sockets in various sizes to meet all demands for this type tool.

Packing gland nut sockets for use with ratchet.

Tee handle valve stem sockets in five sizes with sliding cross handle. Openings from ⅜" to ¾".

Valve stem sockets for use with ratchet. Made in four sizes with openings from ⅜" to ¾".

Packing nut socket specially designed for Kerotest valve.

Drop-Forged ratchets specially designed for refrigeration service work. Made with 3 different size ratchet openings.

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